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THE GLASGOW

MECHANICS' MAGAZINE;

AND

ANNALS OF PHILOSOPHY.

VOL. V.

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W. R. M'PHUN, PUBLISHER, TRONGATE.
EDINBURGH: J. SUTHERLAND.
LONDON: BASIL STEUART, CHEAPSIDE.
1826.

FRIENDS OF SCIENCE,

In concluding the Fifth Volume and First Series of the Glasgow Mechanics' Magazine, we may be allowed to state a few facts relative to the rise, progress, and success of this Work.

An increasing demand for scientific information among the industrious classes of the community, produced by the spirit of inquiry generated in this enlightened era of the world, led to the happy idea of publishing a work for the benefit of such classes alone. This idea, which was natural and in the general excellent, was followed up in the metropolis, by the commencement of the Mechanics' Magazine there. Its execution, however, especially at first, fell far short of what one anxious for the improvement of his species would have anticipated. To comprehend what is meant by this allusion, only requires to look into some of the early numbers of that work. Impressed with the idea that a work more useful and better adapted to the real scientific wants of Mechanics might succeed, we, shortly after the commencement of the London Magazine, began the present work. Success crowned our utmost expectations; the Work was hailed *even in this city* with approbation; and it was UNIVERSALLY ESTEEMED in the country. Difficulties, however, crowded around us; it was impossible to compete on equal terms with the London publication. It was easy there to procure wood-cuts to any extent for the illustration of scientific subjects; here it was impossible, without enormous expence. An engraver in wood was unknown in this part of the kingdom, and to bring one from the metropolis was, in the infant state of the Work, but a hazardous scheme. Copperplates were resorted to as the only alternative, and at an expence at least double that of the London Magazine, while this Work was sold at the same price. Had not, therefore, an extraordinary success followed this attempt, it would have been impossible to have entered the lists with a similar publication, with such an overwhelming difference in expence.

Independently, however, of the immense advantage possessed by the London Magazine over a mere provincial Work, as well as that arising from its having the start, by four months, of this publication, the superiority of the latter soon became apparent, and in a great measure it began to supersede the former in Scotland. Had this Work, therefore, but enjoyed the same advantages, or even the single one of being published in London, and not in a provincial town, there is not a doubt but long ere now, it would have stood alone in its own department of Literature. As it was, to this hour, it has kept up a respectable rivalry with that first Work, and is the only one which has so long kept pace with it in its progress, while many other meritorious Works of a similar kind, both in and out of the metropolis, have risen and again disappeared, after a short and unsuccessful struggle for existence. Suffice it to say, for ourselves, that we could have still carried on the present Series of this Work to an unlimited period, as its circulation in this country, and even in England, may well be called respectable, considering the depressed state of trade. Certain improvements, however, of which both the Work and the times are capable, have induced us at present to delay for a short time the commencement of the new Series. It is with unfeigned regret that we part with many of our staunch friends and supporters in these trying times, but, we hope, at an early period to meet with that cheering and enlivening encouragement from them, which we have so long enjoyed, and for which we shall ever feel grateful. To our own city, we owe *but a small modicum* of thanks, considering our endeavours on their behalf, and we fully intended to have stated how little they have supported us in our undertaking, excepting at the beginning, when the Work and Science were alike novel to the community. It is but too true, that "prophecy," or "Science," or "merit of any kind, has but little honour in its own country," otherwise of the 150,000 inhabitants of Glasgow, many, for their own honour, should have supported "THE GLASGOW MECHANICS' MAGAZINE" more nobly than they have done. But we have finished. In conclusion, we cannot do better than answer the queries lately proposed by that indefatigable friend of Science, Mr. Brougham, in as far as they regard ourselves:

QUERIES FOR THE USE OF MR. BROUGHAM;

Which the Managers of the Mechanics' Institutions are requested to answer; and address—HENRY BROUGHAM, ESQ. M. P. London.

"1. How is the present distress affecting the Mechanics' Institutions?"

Very much, as there has been a regular decrease in the attendance at the Glasgow Mechanics' Institution, and the prospects for the ensuing winter are gloomy.

"2. Are the members and supporters of such Institutions generally the most steady and well behaved; and do they keep their work and wages better, usually, than others?"

That is uniformly the case in Glasgow, and its neighbourhood. No example to the contrary having ever been known.

"3. What is the number of attending members?"

Last year there were only about 800 attended, while at first there were upwards of 1000.

"4. What is the amount of the subscriptions for each member?"

Ten Shillings for Six Months.

"5. What is the state of the Library?"

Excellent in Glasgow.

"6. What Lectures are delivered?"

On Mechanics and Chemistry;—Mathematics;—Political Economy;—Anatomy and Physiology;—and Natural History.

"7. What changes in the rules and plans have been suggested by experience?"

The power of electing Lecturers in the Glasgow Mechanics' Institution, being vested in the Mechanics themselves, experience suggests as an essential improvement, that it be vested in a committee.

"8. What difficulties have they met with?"

Pecuniary difficulties are the worst; and to procure qualified Lecturers the next.

"9. What is the conduct of the members, especially of those intrusted with a share in the management?"

Upon the whole excellent, but liable to the objection stated in the answer to the seventh query.

"10. What number of books have been taken out to read?"

As many as could be got; there is an enormous wear and tear; the scientific works are, however, less in demand than they should be.

"11. What is the state of demand for useful cheap publications?"

Still great notwithstanding the pressure of the times. As an instance, an aged mechanic who had taken out this Work from the beginning, when informed that the present Series was terminated, expressed his most unfeigned sorrow at its temporary cessation, as a want which he could not repair.

"12. What have been the general effects of the Institutions on the general character and conduct of the members?"

The best possible; intelligence—improvement in good conduct;—advancement in business,—and aspiring at the enjoyments of a rational being.

It is not to be understood, that the above answers are at all official on the part of the Institution referred to; they are merely answers founded on such information as *we* could procure, and possibly when they are answered *more in detail*, by the managers of the Institution, they may differ a little in the mode of statement, but we are of opinion, that they are correct in substance. We have merely inserted them in this manner to afford those Institutions, which may not have been supplied with copies of the "Queries," an opportunity of following up the intention of Mr. Brougham, either according to the above example, or to any better method that may suggest itself to their respective managers.

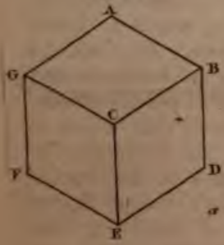
THE GLASGOW
MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

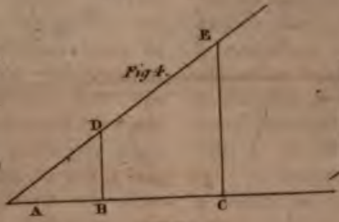
> "That pains we take in books or arts which treat of things remote from the use of life, is but a busy idleness.—*Dr. Fuller.*"

No. CXV. *Saturday, 4th March, 1826.* Price 3*d.*

PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE.

Fig 2.





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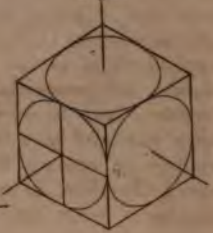

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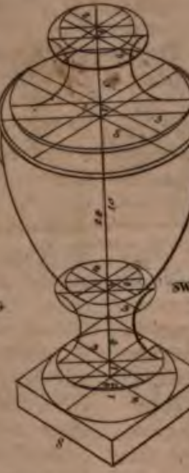

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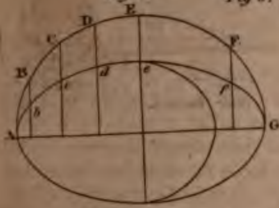


Fig 7.

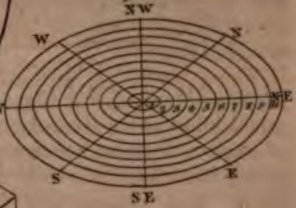


Fig 1.

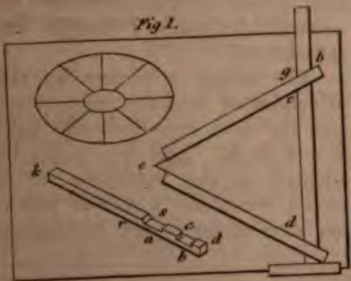
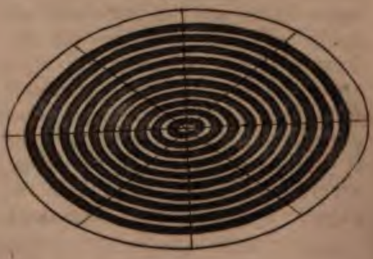


Fig 5.



— Swan Sc. —

PROFESSOR FARISH'S *ISOMETRICAL* PERSPECTIVE.*

In the course of lectures which I deliver in the University of Cambridge, I exhibit models of almost all the more important machines which are in use in the manufactures of Britain.

The number of these is so large, that had each of them been permanent and separate, on a scale requisite to make them work, and to explain them to my audience, I should, independently of other objections, have found it difficult to have procured a warehouse large enough to contain them. I procured, therefore, an apparatus, consisting of what may be called a system of the first principles of machinery; that is, the separate parts of which machines consist. These are made chiefly of metal, so strong, that they may be sufficient to perform even heavy work: and so adapted to each other, that they may be put together at pleasure, in every form, which the particular occasion requires.

Those parts are various: such as, loose brass wheels, the teeth of which all fit into one another; axles, of various lengths, on any part of which the wheel required may be fixed; bars, clamps, and frames; and whatever else might be necessary to build up the particular machines which are wanted for one lecture. These models may be taken down, and the parts built up again in a different form for the lecture of the following day. As these machines, thus constructed for a temporary purpose, have no permanent existence in themselves, it became necessary to make an accurate representation of them on paper, by which my assistants might know how to put them together without the necessity of my continual superintendence. This might have been done, by giving three orthographic plans of each; one on the horizontal plane, and two on vertical planes at right angles to each other. But such a method, though in some degree in use among artists, would be liable to great objections. It would be unintelligible to an inexperienced eye; and even to an artist, it shows but very imperfectly that which is most essential, the connection of the different parts of the engine with one another; though it has the advantage of exhibiting the lines parellel to the planes, on which the orthographic projections are taken on a perfect scale.

This will be easily understood, by supposing a cube to be the object represented. The ground plan would be a square representing both the upper and lower surfaces. And the two elevations would also be squares on two vertical planes, parallel to the other sides of the cube. The artist would have exhibited to him three squares; and he would have to discover how to put them together in the form of a cube, from the circumstance of there being two elevations and a ground plan. This method, therefore, giving so little assistance on so essential a point, I thought unsatisfactory.

The taking a picture on the principles of common perspective, was the next expedient that suggested itself. And this might be adapted to the exhibition of a model, by taking a kind of bird's-eye view of the object, and having the plane of the picture, not as is most common in a drawing, perpendicular to the horizon, but to a line, drawn from the eye, to some principal part of the object. For example: in taking the picture of a cube, the eye might be placed in a distant point on the line which is formed by producing the diagonal of the cube. But to this common perspective there are great objections. The lines, which in the cube itself are all equal, in the representation are unequal; so that it exhibits nothing like a scale. And to compute the proportions of the original from the representation, would be exceedingly difficult, and, for any useful purpose, impracticable: there is equal difficulty, too, in computing the angles which represent the right angles of the cube. Neither does the representation appear correct, unless the eye of the person who looks at it be placed exactly in the point of sight. It is true that, as we are continually in the habit of looking at such perspective drawings, we get the habit of correcting, or rather overlooking the apparent errors which arise from the eye being out of the point of sight, and are, therefore, not struck with the appearance of incorrectness, which, if we were unaccustomed to it, we should feel at once.

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* From the First Volume of the Transactions of the Cambridge Philosophical Society. The method is peculiarly deserving of the attention of Mechanics and Engineers.

The kind of perspective which is the subject of this paper, though liable in a slight degree to the last-mentioned inconvenience, till the eye becomes used to it, I found much better adapted to the exhibition of machinery; I, therefore, determined to adopt it, and set myself to investigate its principles, and to consider how it might most easily be brought into practice.

It is preferable to the common perspective on many accounts, for such purposes. It is much easier and simpler in its principles. It is also, by the help of a common drawing-table, and two rulers,* in-

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* It is unnecessary to describe the drawing-table any further than by observing, that it ought to be so contrived as to keep the paper steady on which the drawing is to be made.

Here should be a ruler in the form of the letter T, to slide on one side of the drawing-table. The ruler should be kept, by small prominences on the under side, from being in immediate contact with the paper, to prevent its blotting the fresh drawn lines as it slides over them. And a second ruler, by means of a groove near one end on its under side, should be made to slide on the first. The groove should be wider than the breadth of the first ruler, and so fitted, that the second may at pleasure be put into either of the two positions represented in the plate, fig. 1, so as to contain with the former ruler, in either position, an angle of 60 degrees. The groove should be of such a size, that when its shoulders, *a* and *d*, are in contact with, and rest against the edges of the first ruler, the edge of the second ruler should coincide with *d e*, the side of an equilateral triangle described on *d g*, a portion of the edge of the first ruler; and when the shoulders, *b* and *c*, rest against the edges of the first ruler, the edge of the second should lie along *g e*, the other side of the equilateral triangle. The second ruler should have a little foot at *k*, for the same purpose as the prominences on the first ruler, and both of them should have their edges divided into inches, and tenths, or eighths of inches.

It would be convenient if the second ruler had also another groove, *r s*, so formed that when the shoulders, *r* and *s*, are in contact with the edges of the first ruler, the second should be at right angles to it. For representing circles in their proper positions, the writer made use of the inner edge of rims cut out from cards, into isometrical ellipses, as represented in the figure; of these he had a series of different sizes, corresponding to his wheels. Such a series might be cut by help of the concentric ellipses in fig. 5; but he thinks that it would be an easier way to make use of that set of concentric ellipses as they stand, by putting them in the proper place under the picture, if the paper on which the drawing is made be thin enough for the lines to be traced through, as by the help comparably more easy, and, consequently, more accurate in its application; insomuch, that there is no difficulty in giving an almost perfectly correct representation of any object adapted to this perspective, to which the artist has access, if he has a very simple knowledge of its principles, and a little practice.

It further represents the straight lines which lie in the three principal directions, all on the same scale. The right angles contained by such lines are always represented either by angles of 60 degrees, or the supplement of 60 degrees. And this, though it might look like an objection, will appear to be none on the first sight of a drawing on these principles, by any person who has ever looked at a picture. For he cannot for a moment have a doubt, that the angle represented is a right angle, on inspection.

And we may observe further, that an angle of 60 degrees is the easiest to draw of any angle in nature. It may be instantly found by any person who has a pair of compasses, and understands the first proposition of Euclid. The representation, also, of circles and wheels, and of the manner in which they act on one another, is very simple and intelligible. The principles of this perspective, which, from the peculiar circumstance of its exhibiting the lines in the three principal dimensions on the same scale, I denominate "*Isometrical*," will be understood from the following detail:—

Suppose a cube to be the object to be represented. The eye placed in the diagonal of the cube produced. The paper on which the drawing is to be made to be perpendicular to that diagonal, between the eye and the object, at a due proportional distance from each, according to the scale required. Let the distance of the eye, and, consequently, that of the paper, be indefinitely increased, so that the size of the object may be inconsiderable in respect of it.

It is manifest, that all the lines drawn from any points of the object to the eye may be considered as perpendicular to the picture, which becomes, therefore, a species of orthographic projection. It is manifest, the projection will have for its outline an equiangular and equilater hexagon, with two vertical sides, and an angle at the top and bottom. The other three lines will be radii drawn from the centre to the lowest angle, and to the two alternate angles; and all these lines and sides will be equal to each other both in the object and representation; and if any other lines parallel to any of the three radii should exist in the object, and be represented in the picture, their representations will bear to one another, and to the rest of the sides of the cube, the same proportion which the lines represented bear to one another in the object.

If any one of them, therefore, be so taken as to bear any required proportion to *its* object, *e. g.* 1 to 8, as in my representations of my models, the others also will bear the same proportion to *their* objects; that is, the lines parallel to the three radii will be reduced to a scale.

I omit the demonstration of this, and some other points, partly for

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of them the several concentric circles will go to the representation of one which might be drawn at once. It is difficult to execute them separately with sufficient accuracy to make them correspond. For this purpose a separate plate of fig. 5 should be had, and one edge of the paper on the drawing-table should be loose to admit of the concentric ellipses being slid under it to the proper place.

the sake of brevity, and partly because a geometrician will find no difficulty in demonstrating them himself, from the nature of orthographic projection; and a person, who is not a geometrician, would have no interest in reading a demonstration.

For the same reason, it is unnecessary to show that the three angles at the centre are equal to one another, and each equal to 120 degrees, twice the angle of an equilateral triangle; and the angle contained between any radius and side is 60 degrees, the supplement of the above, and equal to the angle of an equilateral triangle.

(*To be continued.*)

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, Teacher of Mathematics, Glasgow.

No. I.

The word mathematics originally signified discipline, or learning, (science;) but it is now appropriated to that science which teaches the comparison and mensuration of magnitude. It has also been termed the science of quantity, and in this view, the objects to which it may be applied are equally numerous and various as the objects of our senses; for whatever is the object of our senses, is capable of being considered, either with respect to their number, their extension, or their quantity.

Mathematics are divided into *pure* and *mixed*.

Pure mathematics considers magnitudes generally, simply, and abstractedly, without any relation to matter or sensible objects.—Under this class are comprehended,

1, Arithmetic, or the art of numerical computation;

2, Geometry, which teaches us to measure extension;

3, Analysis, or the comparison and calculation of magnitudes in general;

4, Mixed geometry, or the combination of geometry with analysis.

Mixed mathematics borrow from physics, that is natural philosophy, one or more incontestable experiments, and then, by a demonstrative chain of reasoning, they deduce, from established principles, conclusions as certain as those of pure mathematics.—Under this division are comprehended,

1, Mechanics, the science which treats of the effect of moving powers, or forces, and the laws of motion;

2, Hydrodynamics, which explains the motion of fluids, and the laws of their action;

3, Astronomy, which considers the revolutions and various phenomena of the sun, moon, and other heavenly bodies;

4, Optics, the science of vision, including the properties of light and colours;

5, Acoustics, the theory of sounds.

Mathematics have also been divided into speculative and practical; a division which applies both to the pure and mixed.

Speculative mathematics inquires after knowledge which it is proposed to attain, and simply contemplates the truth or falsehood of what is asserted.

Practical mathematics is the application of the speculative, and shows how to perform something useful or advantageous to mankind.

It is not possible to fix the origin

of mathematics with precision, though we are able to affirm that it goes back to the remotest ages. Josephus asserts that they were studied before the flood; that the sons of Seth were observers of the heavens; that they built two pillars, the one of brick, the other of stone, to commemorate their discoveries, and that Abraham taught these sciences to the Egyptians, who, however, there is reason to suppose, were acquainted with the science previous to the period of the Patriarch's sojournment among them. The most certain and best established opinion is, that the mathematics began to acquire a certain solidity almost at the same period among the Chaldeans and Egyptians, the two most ancient people known in history.

The magi, or priests of Egypt, directed by the laws of their institution to study and collect the secrets of nature, were become the depositaries and dispensers of all human knowledge; but they have been blamed with involving their discoveries in mystery. It is said that Thales travelled into Egypt about 600 years before Christ, and brought the mathematical sciences into Greece; and, whether this be true or not, it is only from this time that we have any certain accounts of them.

With the mathematics of the ancients we are acquainted only through the writings of the Greeks, and we do not possess the necessary documents to estimate the instruction which these derived from their intercourse with the more eastern nations. We know, however, that as soon as the mathematics took root in Greece, their progress was rapid, and the Grecians became, in some measure, the preceptors of all nations. The elementary books collected and arranged by Euclid, have been translated into all languages, and have continued for more than 2000 years to be exclusively taught in every mathematical school—a certain proof of their excellence. The conics of Appolonius hold an equal rank in what has been called the higher geometry. Many other mathematicians laboured in the same field, but the most exalted rank in this legion of honour has been assigned, both by reason and fable, to the sublime genius of Archimedes.

In the accurate sciences which require cool attention, silence, and profound meditation, the Romans never surpassed mediocrity. Useless as the means of attaining the first offices of the state, they were the occupation of a few obscure individuals, remote from the agitation of public affairs. The Roman mathematicians were little more than translators or commentators of Archimedes, Appolonius, &c.

On the death of Theodosius, and the division of the empire, the western part was long ravaged, and at length subjugated by barbarians, and soon sunk into profound ignorance; while the eastern schools were wholly employed in theological disputes. The accurate sciences had taken refuge in the Alexandrian museum, (almost the only refuge they had left them,) which was founded by Ptolemy Philadelphus, about 320 years before Christ. Here the mathematics flourished near ten centuries. But of this asylum they were deprived about the middle of the seventh century, when the Arabs, conducted by the successors of Mohammed, spread carnage and devastation through the east, the museum and library of Alexandria were destroyed.

However, though the chain of mathematical discovery was broken by this fatal catastrophe, a few links remained, which this nation of destroyers, softened by the charms of peace, strove to collect and unite afresh. In less than a century we find the Arabs cultivating astronomy, and their taste for a particular science, gradually extended to all the branches of knowledge. For the space of seven hundred years, the mathematics flourished in the extensive dominions of the caliphs; by the Moors they were carried into Spain, and spread over the rest of Europe. And the Arabs rendered essential service by their translations of the works of the ancient Greeks, with some of which we are acquainted, only through the medium of the Arabic version.

The conquests of the Turks brought back ignorance and barbarism, on the delightful countries which the Arabs inhabited; and extinguished the lamp of science which had long glimmered with fading lustre in the dissolute and desolated provinces of the eastern empire. At the taking of Constantinople by Mohammed II. a persecution arose against artists and men of learning, by which many of them were destroyed; but some escaped, and carried with them the remains of the mathematical sciences into Italy, France, Germany, and England, countries in which a taste for literature had already begun to take root.

From this period, all the branches of the mathematics made rapid progress. The improvements of the moderns have put us in possession of an infinite number of problems, inaccessable to the ancient geometricians. The ancients have given us nearly the whole of what has been termed pure or speculative geometry, few additions have been made to the fundamentals of the science—most of the modern works on plane geometry, or the conic sections are compilations from theirs: but the moderns have improved arithmetic. The ancients knew little, if any thing of algebra, and we claim the sublime invention of fluxions as our own. We have applied the mathematics to the improvement of practical arts and sciences, as mechanics, projectiles, gunnery, astronomy, and optics, far more extensively than they, and they were ignorant of the combination of analysis and geometry which we employ.

But let it not be supposed that the moderns have surpassed the ancients in genius. It is probable that the discoveries which they made, required, in the infancy of science, intellectual exertions as great as any modern improvement. The most important improvements in science have always been preceded by gradual advances. The discovery which astonishes when it is announced, can often be traced through many previous steps which all contribute to bring it to light; and the wonder that it should not have been sooner made is often greater than the surprise which it occasions.

We are possessed of instruments, which are equally just, which arrive by a shorter process at the end proposed; but we are inferior to the ancients in pure geometry. If Archimedes were to return to this earth, with all the wonderful attainments he possessed, he would be obliged to subject himself to a long course of study before he could place himself on a level with Newton, yet Newton lamented that he had too much neglected the strict geometrical reasonings of the Syracusan sage.

EAGLESHAM MECHANICS' INSTITUTION.

"Many shall run to and fro, and *knowledge* shall be increased."

It is highly gratifying to us, while we lay before our readers occasional notices of the establishment of Mechanics' Institutions throughout the country, to be able to state, that, in our own neighbourhood, they are rapidly increasing. Some time ago, a number of the mechanics in the village of Eaglesham, sensible of the advantages of scientific instruction, formed a Mechanics' Institution, under the patronage and support of the minister of the parish, Captain Howie, Mr. Whyte, the proprietor of an extensive public work in the village, and several other gentlemen. About 100 persons enrolled themselves as members in a short time, and the number is still likely to increase.

At the request of the members, Mr. Condie of Anderson's Institution, consented to deliver a short course of lectures on chemistry and natural philosophy, to be continued once a-week. These lectures were delivered chiefly *extempore*, and gave entire satisfaction to the members of the Institution, and the inhabitants of the town and parish who attended the course: displaying as they did an intimate acquaintance with the subjects treated of, and conveying, in language the most suitable, a much more distinct knowledge of experimental science than they would have done, had they been delivered in more scholastic terms. The experiments, also, were conducted in the same style of excellence which he has so often displayed in the Parent Institution, under the direction of Dr. Ure. The consequence of this was, what might have been anticipated, the members of the Institution hearkened to the young lecturer with the deepest attention, and, in proof of this, remained frequently for three or four hours after eight o'clock, his earnest auditors, without the slightest indication of a desire to depart till the lecture was concluded. The attendance increased weekly, and on the concluding evening, when the lecture was for the benefit of the Institution, not less than 300 persons attended, among whom were a number of ladies. Their president, the Rev. Mr. Davidson, Capt. Howie, and several other gentlemen of the place, honoured the lecturer every evening with their presence.

At the conclusion of the course, Mr. Condie was presented by the Rev. President, in name of the members, with an elegant and valuable silver snuff-box, having the following inscription:

Presented to
Mr. John Condie,
By the Members of the Eaglesham
Mechanics' Institution,
In testimony of their Esteem.
1826.

After which the members sat down to an excellent supper in the Cross Keys Inn, where the hilarity of the company was preserved to a late hour. The Reverend President was in the chair, and Captain Howie, Croupier. After the usual loyal toasts, the healths of Mr. Condie, Dr. Ure, and prosperity to Anderson's Institution, the prosperity of the City of Glasgow, &c. &c. were given. The healths of two individuals were also enthusiastically drank, on account of the benefits they had conferred on the town of Eaglesham: these were Mr. Whyte, the proprietor of a cotton mill recently established there, and Mr. Hutchison of Glasgow, both of whom have given employment to a great number of persons in the town and its vicinity.

A number of excellent speeches were delivered in the course of the evening.

It is a very gratifying instance of the advantages which the Parent Institution has afforded to the present generation, that it has raised a young man from the workman's bench to the lecturer's table, and inspired him with that enthusiastic ardour which has enabled him so successfully to impart to others a portion of those benefits he has himself so long enjoyed. It is no small tribute to his merits, too, that he succeeded so well, and gave such universal satisfaction, in a town where he spent many of his youthful days, and where, though not a native of the place, he was well known, from his relationship to individuals belonging to it; so that for once the ancient proverb seems to have been reversed, "that a prophet has no honour in his own country;" we must, therefore, esteem this a happy instance of the increasing liberality of the age.

This Institution has not yet begun to establish a library; but this is of the less importance, since there are already two libraries in Eaglesham—one attached to Mr. Whyte's mill, and another belonging to the town. It is, however, in contemplation to unite these libraries, and, by adding some books on science, to render it available for the members of the Mechanics' Institution. We trust this plan will be carried into effect, as it will not only afford admirable facilities to the mechanics attending the Institution, but to those who are unable to attend it will afford an opportunity of perusing scientific works, which otherwise might not be in their power.

We would recommend to the members of this and all other Mechanics' Institutions, that, during the period which elapses between their different courses of lectures, they should hold monthly meetings for scientific purposes. At these meetings, the plan which has been so successfully adopted and carried on in the Glasgow Gas Work, might be adopted, or some scientific work of interest might be procured, from which portions might be read and discussed, so that not only would an interest in the success of the Institution be kept up, but such a taste for scientific instruction would be acquired, as would materially facilitate their improvement during their next course of lectures, and would considerably diminish the labour of the lecturer, who would thus be able to lead them on to the higher departments of science. Above all things, we would recommend that no opportunity be lost of acquiring apparatus. During the present course there has been no want of apparatus. Mr. Condie, in addition to what he possessed himself, was liberally supplied by some of the scientific gentlemen of this city, who have never been slow in promoting the communication of knowledge to the mechanic. But the sooner Mechanics' Institutions can supply themselves with the necessary apparatus the better, as they then become independent of circumstances.

THE NOTATION OF MUSIC SIMPLIFED. By ALEX. M'DONALD.*

We have been favoured with a sight of the proof sheets of a small work about to be published by Mr. M'Donald, in which he develops a new mode of musical notation. The system is extremely simple, complete in all its parts, and is explained perspicuously and concisely. Instead of the stave in common use, Mr. M'Donald makes use of the letters of the Gamut to mark the elevation of the different notes, thus:—

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* 18mo. pp. 36. Glasgow; F. Melville, 1826.

c d e f g A B C D E F G *a* *b* *c* *d* *e* *f* *g*
𝔉 𝔊 𝔞 𝔟 𝔠 𝔡 𝔢 𝔣 𝔤 *A* *B* *C* *D* *E* *F* *G* a b c

The first line in the Bass Stave is marked by 𝔤, and e marks the first line in the Treble. When these are known, there can be but little difficulty in ascertaining the line or space that any other letter marks.

The Semibreve reduced to the fractional forms $\frac{1}{1}$, $\frac{2}{2}$, $\frac{4}{4}$, marks the first, second, and third Moods of Common Time. The remaining Moods are expressed by the fractional numbers already in use for that purpose. The *Numerals* 1, 2, 4, 8, 16, 32,* are employed to represent the several Notes and Rests, from their being expressive of the relative proportions of these characters. "A *Numeral*, accompanied with one or more Letters, represents a Note: in the absence of Letters, it represents a Rest. Rests for more than one Bar are, like the Moods of Time, expressed fractionally:" thus, $\frac{2}{1}$, $\frac{3}{1}$, &c. "The *Comma* is used as the Substitute of the *Single* Bar; the *Dash* as that of the *Double* Bar." The *Dash*, followed by a Period, marks a Close.

"The Sharp is expressed by the Acute *Accent;* the Flat by the Grave *Accent;* and the Natural, by a small Perpendicular *Line.*" The other Accidental Characters are expressed by the other points used in punctuation; and these are so happily applied, that "each Character, the Shake excepted, bears a striking resemblance to the Original, either in its figure or in its original office."

"The *Initials*, of Treble, Counter, Air, and Bass, serve the purpose of the several Clefs. Any number of Notes may be expressed by an equal number of *Letters* expressive of their respective elevations, and a *Numeral* expressive of the amount of time in which they should be executed. The Numeral always occupies the second place, except in slurred passages, in which it occupies the first. In complex passages, the substitute of the Dot is not annexed to the *Numeral*, as it is in simple passages, except when the Numeral requires to be also dotted. When the additional time is taken from the *following* note, the *Letter* of the dotted note is *followed* by the Apostrophe; but when, from the *preceding* note, it is *preceded* by the Apostrophe, *inverted.*

"When any Accidental Character is situated before a *Letter*, it affects the execution of that Letter only: when situated before a *Numeral*, it affects the execution of the several notes of whose amount that numeral is expressive."

One decided advantage of this system is the great saving of expense which would be effected in publishing music, were it adopted. At present, music is almost invariably engraved on copperplates; and when printed like letter-press, expensive types for the very purpose must be got.

The vast expense thus attending the publication of music, has tended greatly to retard the general knowledge of the science. The number of songs published with the music is very inconsiderable, when brought into comparison with the number published without it. Every one has songs in abundance; but few, comparatively, are in possession of songs set to music. These are circumstances, which, we venture to predict, the amateur will not long have occasion to regret.

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* 6 and 3 are used as abreviations of 16 and 32.

We trust we have said enough to excite the curiosity of our musical readers; and to those who may wish to have this curiosity gratified, we recommend a perusal of the work itself, which may be had for one shilling.

GEOGNOSTICAL OBSERVATIONS.—By Dr. Boue.

1. He has not seen or heard of any shell limestone, true red marl (tod liegende), or quader sandstone, or mangnesian limestone (zechstein), in the whole extent of the Apennines. Sandstone, of the coal formation, is said to occur near Pestum, and the white Apennine limestone, extending from Rome to Calabria, appears, in general, to belong to the third flœtz, or Jura-limestone. 2. The sulphur of the Apennines is not in greywacke, as mentioned in the Synoptical Table published in a preceding number of this Journal; but the great deposit of sulphur, compact and fibrous gypsum, and even of salt, are situated in tertiary clay, as may be seen near to Volterra in Tuscany; and the same will be the case in Sicily. 3. Dr. Boué observes, that there is a gradual transition from talcose mica-slate to some granular foliated limestones or marbles, and from these to compact black marble, shale, and the common alterations of the calcareous greywacke, and sandy limestones of the Apennines, in Tuscany and Eastern Liguria. Such transitions are well seen between Genoa and Nice. This greywacke he believes to be the same as that which he met with on the north side of the Alps, in Austria, and in the Carpathians, and which he has inserted in his synoptical table as red marl, or one of its equivalents. This view is further supported, by the fact of the occurrence of serpentine in the greywacke of Liguria and Tuscany. Dr. Boué adds, "It will therefore be adviseable, in the mean time, that we consider all the deposits refered to the new red sandstone, and placed in his *synoptical table*, under the head North Alps, Carpathians, Apennines, and Capellengebirge, as belonging rather to a newer greywacke, than to new red sandstone; and if this arrangement be correct (for it is still beset with difficulties), the whole mass of limestone and dolomite, of the Northern Alps, put under the head Zechstein, or First Flœtz Limestone, will become a member of the Transition series. To this union of the alpine limestone, and transition limestone, a difficulty occurs, in regard to the salt and gypsum deposit, of the Alps. These, however, we must still consider as secondary. 4. The serpentine, in Liguria, is associated with masses of diallage rock (euphotide), variolite, and compact black diallage porphyry, like that near Girvan in Ayrshire. They occur, in immense bed-like veins, in black limestone, and talcose mica-slate; and the whole is nearly vertically disposed. The mica-slate contains also masses of gypsum; and curious alternations occur, at the lines of junction of the serpentine, with the mica-slate and limestone. In eastern Liguria the serpentine forms distinct veins or

dikes, amongst the calcareous greywacke; which veins widen as they approach the surface, and at length their mass is observed overlying the greywacke, on each side of the vein. At Borghetto and Prato the marly-slates, in the vicinity of the serpentine, are changed into yellowish jaspedeous rocks, resembling these met with near the trap-rocks of Scotland. Similar appearances occur at Girvan in Ayrshire, also in Italy, at Impruneta, Monte Cerboli, near Volterra, north of Florence. The diallage porphyry, and variolite, are always on the under side of the serpentine dikes in Liguria: the variolite has the structure of pearl-stone; and, in some veins, serpentine and diallage rock occur together. When slates, with limestone nodules, are near serpentine, there is sometimes formed a kind of euphotide breccia with nodules of granular limestone. 5. We may add to the alluvial phenomena of the "Synoptical Table," the subterranean volcanic hot aqueous vapours of boracic acid of Monte Cerboli, and also the salses. 6. In the Vicentine are immense dikes or veins of augite porphyry, forming series of hillocks; and in them the gelena and pyrites veins of the Val Zuccanti. The chalk near to the porphyry is converted into a kind of transition limestone. Masses of porphyry were also observed, protruding from the chalk; and near to Schio, M. Passini found the porphyry associated with small masses of granite, like that of Predazza. 7. In the Tyrol the Seefeld fossil fishes appear to occur in bituminous tertiary marl. —*Ed. Phil. Jour.*

COMBINATION LAWS.

Some Account of the Laws relating to the Working People; and of the efforts made to obtain a Repeal of the Laws against Combinations of Workmen.—By FRANCIS PLACE, Esq. *

[Written expressly for the Glasgow Mechanics' Magazine.]

THE most important of all Mr. Hume's useful labours is the repeal of the laws against combinations of workmen to raise their wages or regulate their hours of working. The good effects of this are as yet but partially developed; but whoever will take the trouble to look around him, and observe how much has been already accomplished, will be compelled to acknowledge that the beneficial results have been very great.

It was the universal opinion of the working people, that these laws were the cause of low wages, and this was also the opinion of their employers; it was the opinion of the legislature which enacted them, and they were enacted for the express purpose of keeping wages low. Thus it appears that the same mistake was made by every body;—and it will presently be shown, that this erroneous notion influenced the proceeding of our government from a very early period. The fear of high wages, and the desire to keep the people as dependent as possible, seems to have governed our legislators in every thing relating to them.

The working people expected, and their employers feared, that if these laws were repealed, a great and sudden rise of wages would take place. But circumstances, which have occurred since the repeal, have done much towards removing this erroneous notion, and in a short time it will cease to exist. The removal of these vain hopes and groundless fears is a great good. The constant state of apprehension on the part of the masters, from the opinion they entertained of the power of those they employed to demand and obtain whatever wages they pleased, if not prevented by laws which enabled the masters to coerce them, and the perpetual and powerful persuasion entertained by the men, that their wages were kept down far below the amount which, but for the laws, they would rise to, were among the principal causes of the dislike and hatred which prevailed between the employer and the employed. Each looked upon the other as an enemy, and this very frequently produced conduct such as enemies are but too apt to adopt towards each other. This enormous evil has been greatly mitigated, and they have ceased, to a very great extent, to regard each other as enemies. The master no longer sees in his workman a miscreant who had a constant desire, and only wanted the liberty of which the law had justly deprived him, to r[illegible] with impunity to any amo[illegible] notwiths. The workman no lo[illegible] highly calamitous [illegible]ployer a pitiless tyrant, immediate effects, [illegible] of an iniquitous law, plundered him of the fair reward of his labour, and ground him down to the earth, that he might deprive him of the money which was justly his due, but was unjustly withheld from him. If the repeal of the Combination Laws had done no more than this, it would have been a great blessing to the people, and conferred great honour on the man who, by his knowledge and perseverance, had procured the repeal.

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* This Essay was meant to accompany the Memoir of Mr. Hume, in our Supplementary Number, about to be published; but owing to the necessary length to which it has extended, this was impossible.

Another, and scarcely less important circumstance is, the abolition of illegal secret oaths. The constant fear of persecution led workmen to devise various means to defeat the law, and to secure themselves from the consequences.—Every such device did injury to the whole body which adopted it, and the more successfully they practised their devices, the greater was the moral mischief. The most pernicious of all these devices was the taking of secret and illegal oaths, and yet this practice prevailed to an enormous extent. The laws were so partial, so unjust, and so unduly severe, that it was utterly impossible they could be respected by the working people, and it was to be expected that they would violate them as often as they could, and in every possible way. The laws were more blameable than the people who violated them, but these did not lessen the moral mischief. A man who had once taken a secret and illegal oath, as solemnly administered as, under such circumstances, it could be, in the presence of his fellows, all of whom had been likewise sworn, for the purpose of insuring his concurrence in a breach of the laws, and for the purpose of inducing him to hold every man in his business, who did not equally degrade himself, as his personal enemy, had taken a long stride towards qualifying himself for many mischievous purposes. This oath-taking must have been, and, it must be evident to every body, was, an enormous evil. The abolition of this in every way to be deprecated practice, is another good consequence of Mr. Hume's admirable exertions.

It needs only to be mentioned to be assented to at once, that, wherever this secret oath-taking prevailed, men of bad character would necessarily become leaders, and that this was so there is abundant proof. But now when it is no longer necessary for workmen to hold their meetings in secrecy, the practice of administering illegal oaths has ceased; there needs no such bond of union, and the best instead of the worst among the people have become leaders: the good which has already resulted from this is great, and that it will increase there can be no doubt.

Another monstrous evil, the consequence of the Combination Laws, was the persecution to which the working people were liable, and which many were compelled to endure. This is not the place, on account of the limited space of such a publication as this is, to give an account of these persecutions, and the sufferings of many honest and respectable persons under them. All that can here be said, and now, when these persecutions have ceased, all that is perhaps necessary to say, is, that they were so frequent, so cruel, so vindictively carried on, that, if related, they would hardly be credited. A very few years hence, the recital will no doubt cause the utmost astonishment; it will scarcely be conceived as possible, that in the nineteenth century such things could have taken place in Great Britain.—Happily the time has passed away, when a judge from the seat of justice could tell men of good character that combining to raise their wages "was *worse than felony, and nearly as bad as murder*."

During the continuance of these bad laws, workmen could not associate to discuss their grievances—to compare their actual condition with other times, or with other persons—to ascertain the causes of their poverty, and suggest remedies. Whenever they did meet, it was not to inquire, but to complain; to give vent to exasperated feelings, and to encourage one another in the hope that, sooner or later, they should have an opportunity of avenging or revenging themselves on those whom the laws pointed out as their ever vigilant and unrelenting enemies. It was utterly impossible for them to ascertain the real causes of the evils they suffered, and the wrongs, real or imaginary, they endured. Did any one venture to allude to the real causes, excepting those which were produced by the Combination Laws, he was instantly suspected, and looked upon as an enemy; his opinions were scouted, and himself insulted. Thus all hope of information on these, to them, most important subjects, was excluded. The repeal of the Combination Laws has removed these impediments to knowledge, and workmen can now freely discuss all matters relating to their condition and their interests, as every other class in society always could, but from which the law excluded them.

The late attempts to raise wages are lessons which will never be forgotten. These attempts were conducted on a much larger scale than they ever before were; they were much more ably conducted than such attempts on former occasions were; they were also supported in a manner wholly unprecedented; yet they failed, and proved, practically, that wages had not been regulated by the Combination Laws, but that labour, like other commodities, had its market price; that it was regulated as to price, by the supply and demand; multitudes became convinced of these important truths, and that if, while there was employment for one only, two were produced to do the work, that the two would have no more than the wages of one between them. Of all things which are of importance to the working people, the most important by far is a knowledge of the principles which govern profits and wages, including, of course, the principle of population, and as "to know the cause of a disease is said to be half way to a cure," so will the cause of inadequate wages, when it shall come to be clearly and generally understood, lead to a remedy; means will be found to prevent that greatest of all evils—inadequate wages.

These are among the many good consequences which have resulted, and many others no doubt will result from the repeal of the Combination Laws.

Several years have passed since Mr. Hume first turned his attention to the operation of the laws against combinations of workmen, but before we advert to the efforts made by him to procure their repeal, it may not be amiss to take a rapid survey of some of the most important laws which were from time to time made to restrain the working people from raising their wages, and to compel them to accept such wages as the statute law directed, or the caprice of a justice of the peace led him to order should be taken, and which ultimately induced the legislature to the enactment of the laws against workmen combining to raise their wa[illegible] r to regulate their hours of w[illegible] called the Combin[illegible]

Af[illegible] est, the lands of Eng[illegible] we[illegible] given by the conqueror to a small number of his followers, or held by himself for his own use and emolument, and the labouring people were placed in a state of slavery; the number of free workmen being very few. Many circumstances occurred which tended to the alienation of land, to the increase of trade in the towns, and the emancipation of the common people from their state of bondage.

In the year 1348—the great plague which desolated Europe, reached this country, and so thinned the people that enough were not left to do the work required; and as by this time a large number of workmen were free, they of course demanded higher wages than they had been accustomed to receive. Upon this a statute or ordinance was made in the twenty-third year of Edward III. A. D. 1349, which has since been called the Statute of Labourers. It recited, "that because a great part of the people, especially of workmen and servants, lately died of the pestilence, many seeing the necessities of masters, and great scarcity of servants, will not serve unless they may receive excessive wages," and it therefore enacts, "that every man and woman who have not of their own the means to maintain himself or herself, without labour, shall, if required, be bounden to serve him, which so shall require, and take only such wages, meed, or salary, which were accustomed to be given in the place where he oweth to serve the twentieth year of the king, or five or six common years before; and if any such man or woman, being so required to serve, will not the same do, that being proved by two true men, the sheriff, or bailiff, or constable of the town where the same shall happen to be done, he shall be taken by them or any of them and committed to the next gaol, there to remain under straight keeping till he find security to serve as aforesaid." It then further enacts, that no more wages shall be paid than was formerly paid, under any pretence or in any way, under the penalty of double the amount so paid.

This is the first statute extant, and probably the first ever made to compel free labourers to take any particular sum for their labour. Sir F. M. Eden, in his work on the state of the poor, observes, that "notwithstanding the plague was highly calamitous to the nation in its immediate effects, it was not without beneficial consequences to the labouring classes, since it inspired those who survived with just ideas of their own importance."

Many ways of evading the statute were resorted to. The demand for labour was greater than the supply; and as all the work which was desired to be done, could not be done, those who could pay best, or whose necessities would not allow of delay, were sure to decoy the labourers from others, and thus the law was soon found to be an inadequate remedy for the supposed grievance of high wages.

Complaint was made to the next parliament, held in the ensuing year, that the statute was not obeyed, another statute was therefore passed, which, after reciting the former statute, directs, that in addition to the punishment thereby provided, "all labourers and servants shall be sworn to serve, and if they do not serve and take the wages directed by the law, or refuse to take the oath, they shall be put in the stocks for three days or more, and fined, ransomed, and imprisoned, after the discretion of the justices." This unlimited power to compel compliance with the law, was given to any justice of the peace, but the law was absurd, was equally inimical to the interests of those who wanted labour performed, and of the labourer, and therefore, however much it might be made an annoyance to individuals, it could not be executed. Other attempts were made by statutes in the thirty-first and thirty-fourth years of the same king, to compel labourers and their employers to comply with the two preceding statutes, and additional penalties were, by the statute of the thirty-fourth, enacted. By this law those who refused to work, and absconded into other counties, that is, any man or woman who left the county he or she lived in, and went to another county to seek employment, was to have the letter F burnt upon his or her forehead with a hot iron. Still the law could not be executed, and it was again confirmed in the forty-third year of the same king.

Edward III. was succeeded by Richard II. This mischievous king came to the throne in 1377. During his reign the laws of Edward were continued, and others were made to enforce obedience. A slight deviation was, however, made by an act, which, in certain cases, permitted the magistrates to fix the rate of wages.

Henry IV. succeeded Richard in 1399. In the fourth year of his reign, workmen were, by statute, prohibited from being hired by the week, or being paid for holidays or half holidays. One of the ways of evading the law, was by hiring for a week, paying for the festival days, which were many, and on which, or half of which, labourers did not work, and also by paying them for seven days a-week. This statute was intended to prevent these evasions; but it seems to have produced but little effect; for, in the seventh year of this king's reign, all the old oppressive and absurd statutes were re-enacted, under dreadfully severe penalties.

A statute which had been passed in the twelfth year of Richard II. was also confirmed. It enacted, "that he or she which use to labour at the plough and the cart, or other labour or service of husbandry, until they be of the age of twelve years, that henceforth they shall abide at the same labour, without being put to any mystery or handicraft;" and it was now further enacted, "that no man or woman, of what state or condition they be, shall put their son or daughter to serve as an apprentice to no craft nor other labour, except he have land or rent to the value of twenty shillings by the year." These twenty shillings in those days were a considerable sum, compared with twenty shillings now. Thus, no person who was not a freeholder, was permitted to apprentice his son to any trade whatsoever. The law did not, to be sure, declare him a slave; but it, in fact, made him one: 1st, by preventing him learning a trade, and compelling him to be a labourer or drudge; and 2d, by confining him to the spot on which he was born, from which he dared not remove, under the penalty of the stocks, imprisonment, and branding on the forehead. The oppression of these laws was horrible, and shows at once what a barbarous state this country was in.

By the 6th and 8th of Henry VI.—1438—1440, justices were to set the wages of artificers and workmen by proclamation. Certain meetings of workmen were, in this reign, made felonies.

In 1496, in the reign of Henry VII. wages were again regulated; and notwithstanding the price of the necessaries of life had greatly increased, the wages of labour were not at all increased. The punishment was declared to be three days and nights in the stocks, and bread and water only; and for the second offence six days and nights in the stocks, with the like fare.

Henry VIII. made several statutes against the working people. By an act passed in 1530, "any man or woman being hole and mighty in body, and able to labour, be vagrant, (that is, who may remove from one place to another,) the justices, high constables, mayors, sheriffs, or bayliffs, by their discretions shall cause every such person to be tyed to the end of a cart naked, and be beaten with whips, until his body be bloody by reason of such whipping." They are then to be enjoined to go by the nearest way "to their usual place of residence, and there put himself to labour, like a true man ought to do." Certificates of punishment were to be given to enable them to beg their way. It was further enacted, that those who, having been punished, shall offend a second time, "by wandering, loitering, or idly using himself, and playing the vagabond, or absenting himself from such labour as he shall be appointed unto, he shall be whipped again, and have the upper part of his right ear cut off. If he offend again, he shall have judgment to suffer pains and execution as a felon and an enemy to the commonwealth;" that is, he shall be hanged. This barbarous statute remained in force during this king's reign, during the long reign of Queen Elizabeth, and until the twenty-first year of her successor, James I.

Such were the laws the "*wisdom of our ancestors*," in their state of ignorance and barbarism, provided; and such the punishments they inflicted on the working people, who were regarded much in the same light as we now regard refractory and untameable animals;—such was the usage which the sages of those days thought fit to establish as adequate and proper to be observed;—and such were the pains and penalties they thought might be reasonably inflicted on the great body of the people, for acts which a more intelligent legislature has declared are no crimes, nor any offence whatever.

The great purpose to be obtained by these statutes was, the keeping down wages as low as possible;—their maxim was, as Dr. Smith has accurately observed, "all for ourselves, and nothing for any body else."

(*To be continued.*)

MISCELLANIES.

To reduce Charcoal to powder.—It is put in a large mortar with a close lid, through which a vertical axis passes to the bottom. Through mortices in the lower part of this axis are put two arms, which divide the mortar into four quadrants. In two opposite quadrants are put two large bombs, or solid balls, and to two opposite arms on the lower side are fixed rakes. When the vertical axis is turned, it is easy to conceive how the charcoal would be bruised, raked up, bruised again, and so on, till reduced to powder. The vertical axis may be turned by water, or any other power.

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"More learned men grow mad and brain-sick with a pride of that learning they think they have attained, than in the pursuit and acquest of it."—*Bishop Hales.*

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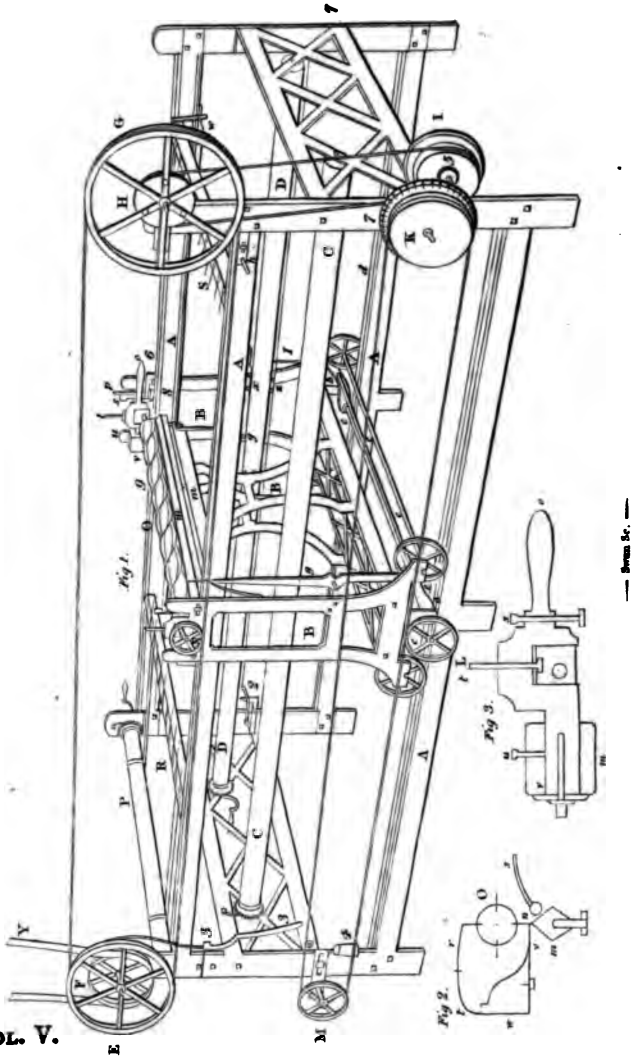
BATHGATE'S IMPROVED MACHINE FOR DRESSING WOOLLEN OR OTHER CLOTHS.



BATHGATE'S MACHINE FOR DRESSING WOOLLEN CLOTHS, &c.

Communicated by Mr. THOMAS ANDERSON, Gallashiels.

GENTLEMEN,—Among the numerous improvements on machinery (from the application of steam power to that of mice) which appear in your valuable Magazine, I shall be happy to see the description of the following machine have a place.

The machine was invented in America, and was introduced into this country about six or seven years ago: since that time, numerous and great improvements have been made on it, but the following, constructed by Mr. Bathgate, Gallashiels, is one of the latest and most approved kind.

The purpose of the machine is to dress the surface of woollen or other cloths, in order to remove those fibres of the threads which give the fabric a rough and coarse appearance, and to reduce the whole to an even and uniform surface.

Fig. 1 is a perspective view of the machine. Fig. 2, a cross section of the cutters. And fig. 3, a longitudinal section of the hand and head which carries the spiral cutter, and showing the manner by which it is connected with the other cutter.

A, A, A, A, (fig. 1,) large cast-iron frame. B, B, B, moving frame or carriage, supported by four wheels on two axles, lying across; the wheels move along the bottom rails of the large frame, A, A, by the sides of the racks, *d*, *d*, which are screwed to these rails. E, a grooved pulley, turning on a pivot, screwed fast into the large frame, and giving motion to the rest of the machine. F, two sheaves, one of which being screwed fast to the pulley, E, causes it to revolve by means of a strap, *y*, passing from any other machinery; the other is a loose sheaf, moving freely on the pivot. N, a pulley on the end of the spiral cutter, and driven by a cord, passing once round it from the pulley, E. G, a pulley, with the same cord passing round it, and sliding on the frame, A, A, to tighten the band when necessary. H, a conical pulley, with three grooves screwed fast to the pulley, G. I, a conical pulley, similar to H, and driven by it, but with its base in the contrary direction; the three grooves are for giving different motions to the moving carriage, B, B. 5, a pinion, made fast to the pulley, I. J, a wheel driven by the pinion, 5. K, a pulley screwed fast to the wheel, J. L, a pulley on a spindle attached to the moving frame, and driven by K. M, a loose pulley, sliding on the frame, A, being what is termed a *stenting pulley*. O, the spiral cutter, formed of a cylinder of cast-iron, with pieces of thin steel inserted into grooves cut round it in a spiral manner, and projecting about half an inch from its surface: the other cutter is a thin plate of steel, screwed to the metal bar, *v*, fig. 2, and by the rotatory motion of the spiral cutter, they act like a pair of shears. *m*, a square bar of iron, made straight on the top, and placed diagonally directly under the edge of the lower cutter, *v*; a pin with two nuts is made fast into each end of this bar at right angles with it, these pins serve to screw it fast to the top bar, *n*, of the middle part of the carriage, B, B, and by the two nuts it is raised to any height corresponding with the cutters. *o*, a handle which supports the spiral cutter; the other end of this handle is made to fit a mortice in the end of the metal bar to which the lower cutter is screwed, and for this purpose a thick piece is cast on each end of the bar, part of which is seen at *v*; it slides in this mortice by means of a screw with two collars working in a plate, as seen at *v*, fig. 3; and it is held fast in the required position by the screw, *u*. By these means the cutter, O, is brought to the right position for cutting with *v*, and it is evident that as *v* wears, O will require to be moved back that the cutting edges may act upon each other. To raise or depress the cutter, O, (which is also necessary,) the bearing on which it rests is fitted with a groove into the handle, *o*, which keeps it fast sideways, but leaves it at liberty to move freely up and down; and this it does by means of the pin, *t*, which works with a screw in the handle, and with a collar in the brass bearing of the cutter, see fig. 3. Into each end of the bar, *v*, is inserted a small pin, shown by dots at *m*, fig. 3: these pins rest upon bearings in the metal plates, 6, 6, which are screwed to the ends of the carriage, B, B, and by slits in that frame they can be moved backward or forward, so as to bring the edge of the lower cutter directly over the bar, *m*.

The cutters move upon the pins dotted at *m*, fig. 3, as centres, when the handle, *o*, is raised up, and are held fast in that position by a spring, *p*, catching on a knob on the outside of the handle, thus permitting the cloth to pass freely between the cutters and the bar, *m*, when the machine is at rest. A pin, *s*, screwed in the handle, *o*, rests upon a projecting piece, 8, of the plates, 6, 6, and serves to regulate the cutters at any distance from the bar, *m*, corresponding to the thickness of the cloth, or the closeness to which the wool is wished to be cut: *a* and *b* are two levers moving on centres at *a* and *b*, and carrying on their shortest end the axle of the pulley, L, on which is fastened two pinions, *c*, *c*, working into the racks, *d*, *d*, and by them the carriage, B, B, is impelled forward: the other end of these levers are connected firmly together by the bar, *e*, *e*; the weight of this bar acting upon the long end of the levers counterbalances the pulley, L, with its axle, and thus, when left at liberty, lifts the pinions out of geer: to retain the pinions in the racks, another lever, working on a centre at *g*, catches on the end of the lever, *a*, and is held there by a spring at the top. The lever, *b*, is connected with the handle, *x*, by a small rod, 1, the handle, *x*, moves upon a centre at *y*, and at *x* there is a small pulley; two similar pulleys are rivetted to the frame, B, at *z*; one end of a cord passing below these last, and over the pulley at *x*, is fastened to the end of the large frame, A, at 7, by a pin and ratchet, the other end is fastened to the arm of the crank, 2; the crank is connected with the lever, 3, which throws the strap, Y, upon the fast and loose sheaves at F alternately.

S is a hooked bar, moveable on centres in the sides of the frame, A, A, but is held fast, when level, by a spring catch, *w*. R is a similar bar, but slides along the projecting pieces of the sides, A, A, and is connected with the roller, P, by two leather straps.

To work with the machine, the cloth, (which is shorn across the web,) is first rolled upon the roller, C, C, thence the end of it is passed round the outside of the top rail of the large frame, A, and the cutters are raised up between them and the bar, *m*, to the other side of the machine, it is then hooked to the bars, S and R, and made tight by turning the roller, P, which is held fast by a catch and ratchet, as the other rollers also are; the carriage is now moved back to R, the spring, *p*, pressed back, and the cutters lowered. The handle, *x*, is next pulled up, which throws the pinions, *c*, *c*, into the racks; and, at the same time, the pulley at *x*, by rising up, shortens the cord and pulls the arm of the crank, 2, which brings the lever, 3, to the position seen in the drawing, thus throwing the strap, Y, upon the fast sheave at F. The whole is now in motion, and the carriage, B, moves towards S; here a stud, *h*, strikes the top of the lever, *g*, and pressing it back, leaves the levers *a* and *b* at liberty, when the bar, *e*, immediately falling down, raises up the pinions, and pulls down the handle, *x*, which leaves the lever, 3, to be acted on by the weight, 4; and by this means the strap, Y, is thrown upon the loose pulley, and the whole is at rest. The cutters are now raised up, and the cloth unhooked at S, by turning up the bar on its centres, and it is held in this position by the spring, *w*, pressing against it; it is then unhooked at R, and the part finished drawn over the other side of the large frame, and hooked to the roller, D, upon which it is rolled up as it is finished; the bar, S, is then brought to its former position, and proceeded with as before.

A small rod of iron, *n*, fig. 2, is connected by three arms to the slender bar, *s*, which is bolted to the top of the carriage, and serves to keep the cloth steady as it passes over the bar, *m*. There is also a piece of plate-iron, *t*, screwed to the bar, *v*, at *w*, to prevent the flocks (the fibres which are cut off,) from being scattered on the finished piece; to the front of this iron, at *r*, is sewed a piece of coarse cloth, touching the cutter, O, which being saturated with it, oils the cutters and diminishes the friction. These parts described are not drawn in the perspective figure.

The length of the machine is made according to the breadth of the cloth intended to be cut upon it—that in the figure is made for cutting nine quarters. At the mean motion of the carriage, the spiral cutter makes one revolution for one-eighth part of an inch moved forward, and as there are four projecting pieces of steel, each will only have to cut at once the thirty-secondth part of an inch.

I am, GENTLEMEN, yours, &c.

T. A.

Gallashiels, 28th Feb. 1826.

P. S. I should be greatly obliged to D. S., Cupar, if he would let us know how he finds the constant number 5.4 to be a multiplier for the head of water in determining its velocity.

I am, GENTLEMEN, yours, &c.

T. A.

Gallasheils, 1st March, 1826.

PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE.

[Continued from page 4 of the present Volume.]

IN models and machines, most of the lines are actually in the three directions parallel to the sides of a cube, properly placed on the object. And the eye of the artist should be supposed to be placed at an indefinite distance, as before explained, in a diagonal of the cube produced.

Definitions.

The last mentioned line may be called the *line of sight.*

Let a certain point be assumed

in the object, as, for example, C, fig. 2, No. CXV. and be represented in the picture, to be called, the *regulating point.* Through that point on the picture may be drawn a vertical line, C E, fig. 2, No. CXV. and two others, C B, C G, containing with it, and with one another, angles of 120°, to be called the *isometrical lines,* to be distinguished from one another by the names of the *vertical,* the *dexter,* and the *sinister* lines. And the two latter may be called by a common name—the *horizontal isometrical* lines. Any other lines, parallel to them, may be called respectively by the same names. The plane passing through the dexter, and vertical lines, may be called the *dexter isometrical plane;* that passing through the vertical and sinister lines, the *sinister plane;* and that through the dexter and sinister lines, the *horizontal plane.*

By the use of the simple apparatus described in the note, page 3, No. CXV., the representation of these lines in the objects may be drawn on the picture, and measured to a scale, with the utmost facility, the point at the extremity being first found, or assumed. The position of any point in the picture may be easily found, by measuring its three distances, namely, first, its perpendicular distance from the *regulating horizontal plane,* (that is, the horizontal plane passing through the regulating point,) secondly, the perpendicular distance of that point where the perpendicular meets the horizontal plane, from the regulating dexter line; and thirdly, of the point where that perpendicular meets the dexter line from the regulating point; and then taking those distances reduced to the scale, first, along the dexter line, secondly, along the sinister line, and thirdly, along the vertical line, in the picture. These three may be called the *dexter distance* of the point, its *sinister distance,* and its *altitude.* And it is manifest they need not be taken in this order, but in any other that may be more convenient to the artist, there being six ways in which this operation may be varied.

If any point in the same isometrical plane with the point required to be found, is already represented in the picture, that point may be assumed as a new regulating point, and the point required found by taking two distances; and if the new assumed regulating point is in the same isometrical line with the point, it is found by taking only one distance. And this last simple operation will be found in practice all that is necessary for the determination of most of the points required. Thus any parallelopiped, or any frame work, or other object with rafters or lines lying in the isometrical directions, may be most easily and accurately exhibited on any scale required. But if it be necessary to represent lines in other directions, they will not be on the same scale, but may be exhibited, if straight lines, by finding the extremities as above, and drawing the line from one to the other; or sometimes more readily in practice by help of an ellipse, as hereafter described.

If a curved line be required, several points may be found sufficient to guide the artist to that degree of exactness which is required.

The method of exhibiting the representations of any machines, or objects, the lines of which lie, as they generally do, in the isometrical directions; that is, parallel to the three directions of the lines of the cube, is as has been already shown; and likewise the mode of representing any other straight lines, by finding their extremities; or curved lines, by finding a number of points.

But in representing machines and models, there are not only isometrical lines, but also many wheels working into each other, to be represented. These, for the most part, lie in the isometrical planes. And it is fortunate that the picture of a circle in any one of these planes is always an ellipse of the same form, whether the plane be horizontal, dexter, or sinister; yet they are easily distinguished from each other by the position in which they are placed on their axle, which is an isometrical line, always coinciding with the minor axis of the ellipse.

This will be obvious from considering the picture of a cube with a circle inscribed in each of its planes, fig. 3, No. CXV. and considering these circles as wheels on an axle. The two other lines (or spokes of the wheel) in the ellipse, which are drawn respectively through the opposite points of contact of the circle with the circumscribing figure, are isometrical lines also; for the points of contact bisect the sides of the circumscribing parallelogram, and therefore the lines are parallel to the other sides. They give likewise the true diameter of the wheels, reduced to the scale required. It further appears from the nature of orthographic projection, that the major axis of the ellipse is to the minor axis, as the longer to the shorter diagonal of the circumscribing parallelogram, that is, (since the shorter diagonal divides it into two equilateral triangles,) as the square root of three to one; as appears from Euclid, Lib. I. Prop. 47: and since the sum of the squares of the conjugate diameters in an ellipse is always the same, if we put $\sqrt{1}$ for the minor axis, the $\sqrt{3}$ for the major, and i for the isometrical diameter, we shall have $2\,i^2 = 1 + 3, = 4$, and $i = \sqrt{2}$.

Therefore the minor axis, the isometrical diameter, and the major axis, may be represented respectively by $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$, or nearly by 1, 1·4142, 1·7321; or more simply, though not so nearly, by 28, 40, 49.

These lines may be geometrically exhibited by the following construction:—

Let A B, fig. 4, No. CXV. be equal to B D, and the angle at B, a right angle. In B A, produced, take B α = to A D, draw α D, and produce both it and α B. Then will B D, B α, and α D, be respectively to one another, as $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$, by Euclid I. 47. Therefore, if α C be taken equal to the isometrical diameter of the ellipse required, C E drawn perpendicular to it will be the minor axis, and α E the major axis. The ellipse itself, therefore, may be drawn by an elliptic compass, as that instrument may be properly set, if the major and minor axes are known. If it is to represent a wheel on an axle, care must be taken to make the minor axis lie along that axle. In the absence of the instrument it may be drawn from the concentric ellipsis, fig. 5, No. CXV. which may be placed under the paper, in the position above described, and seen through it; if the paper be not too thick, and in this method the smaller concentric circles of the wheel may be described at the same time, as they may be seen through the paper, or if they should not be exactly of the right size, it would be easy to describe them by hand between the two nearest concentric ellipses; and thus also the height of the cogs of a wheel in the different parts of it may be exhibited longer and narrower towards the extremities of the minor axis.

Their width may be determined from the divisions of the ellipse. In most cases this may be done with sufficient accuracy from the circumference of the ellipse being divided into eight equal divisions of the circle, by the two axes, and two isometrical diameters, each of which parts may be sub-divided by the skill of the artist; and not only the face of the wheel in front may be thus exhibited, but the parts of the back circles also, which are in sight, may be exhibited by pushing back the system of concentric ellipses on the minor axis or axle through a distance representing the breadth of the wheel, and then tracing both the exterior and the interior circles of the wheel, and of the bush on which it is fixed, as far as they are visible. Care should be taken to represent the top of the teeth, or cogs, by isometrical lines, parallel to the axle, in a face-wheel, or tending to a proper point in the axle in a bevel-wheel. And nearly in the same way may the floats of a water-wheel be correctly represented. If a series of concentric ellipses, such as are given, fig. 5, No. CXV. be not at hand, it will still be easy for an artist to draw the ellipses with sufficient accuracy for most purposes, by drawing through the proper point in the axle, the major and minor axes, and the two isometrical diameters, thus making eight points in the circumference to guide him.

(*To be continued.*)

COMBINATION LAWS.

Some Account of the Laws relating to the Working People; and of the efforts made to obtain a Repeal of the Laws against Combinations of Workmen.—By FRANCIS PLACE, Esq.

[Written expressly for the Glasgow Mechanics' Magazine.]

(Continued from page 16 of the present Volume.)

AT the accession of Queen Elizabeth, the laws respecting workmen were numerous and complicated. Arbitrary power was lodged in the hands of justices of the peace, sheriffs, bailiffs, and constables, who might execute them as they pleased. The people were degraded, treated with the greatest cruelty, and wholly shut out from all chance of redress, however ill treated they might be.

In the fifth year of this queen's reign, some amellorations took place. The laws were somewhat digested, and made more precise and intelligible. It is remarkable that this was the first attempt made, during a space of two hundred years, to consolidate these laws; and what is still more remarkable, as the author of the "Digest of the Laws respecting Masters and Work People" has observed, is that no further attempt to consolidate a yet more incongruous mass of laws relating to this subject, should have been attempted till the year 1823, a period of 260 years. But this, although remarkable, ought to surprise nobody who observes the absurd way in which laws are made in this country. Almost every new act is a project of some one who has local or personal interests to promote. It is generally made without much or any reference to the state of the laws on the same subject; and as there exists no means by which it becomes the duty of any one, or any body of persons, to see that it accords with, or conforms to, or does not, in fact, run counter to other laws, our statute book becomes a mass of confusion, uncertainty, and contradiction, of which the Poor Laws are a striking example.

The statute 5th Elizabeth, chapter 4,

was a material improvement on the barbarous laws which had prevailed; but that statute itself was unjust, vexatious, and oppressive, to a monstrous extent. It was also imperfect, as it did not repeal some of the worst laws which have been noticed. It still treated of the working people as of slaves; it confined them to their localities; compelled them to labour, and to accept for their labour the sums settled by justices, and not by contracts with their employers; it admitted of no hiring in any of the principal trades, except for a year; and it commanded all who were hired by the day or week in the summer months, to be at their work at or before 5 o'clock in the morning, and not to quit it until between 7 and 8 o'clock in the evening; it excluded vast numbers of persons putting their children apprentices, unless they were freeholders; it, in fact, put the whole of the working people completely in the power of the justices, sheriffs, bailiffs, constables, and churchwardens, and left them no will of their own. This act was explained, continued, and altered during the reigns of Elizabeth, James I., and Charles I.; every such alteration being intended to keep down the working people. All these laws were, however, relaxed during the time of Oliver Cromwell, and were never again revived with their former cruelty. Many acts were, however, passed to regulate wages and hours of working. Most of these were local, or related to some particular trade or branch of trade—all founded on the absurd notion that it was for the interests of commerce and agriculture that the people should be kept as poor and as humble as possible.

From the restoration of Charles II. several laws respecting workmen were enacted; but no restrictive laws specially applicable to combinations was made till the 12th George I. A. D. 1727, when all combinations of workmen in the woollen trade were declared illegal, and were to be punished by fine and imprisonment. Subsequently acts were passed extending the law to other trades, particularly the 22d George II. c. 22, which included the hat, linen, fustian, cotton, iron, leather, flax, hemp, mohair, or silk trades and manufactures. In 1796, the law was extended to paper makers. In 1799, it was extended to workmen generally; and in the next year, the act of 1799 was repealed, and the act emphatically called the Combination Law was passed. It will have been seen how, for several ages, these laws, always found inefficacious, were extended, and became more and more cruel in their enactments, as well as how they again declined in severity, until the passing of the general combination act in 1800. This law, partial and unjust as it was, was mildness itself when compared with the laws of the "olden time," and even with the statute of Elizabeth. It was, however, an exceedingly oppressive law; and when taken in consideration with the altered condition of the working classes, was probably more inimical to their notions and feelings than the more severe laws had been to their more barbarous ancestors. But be this as it may, the law was not by any means sufficiently severe to satisfy the wishes of either the employers of workmen, or the judges of the land, and recourse was therefore had to what was called the common law; and convictions obtained under this vague denomination, were punished with much greater severity than they could be under the combination laws. The mode of proceeding was by indictment for conspiracy. This was effected by the perversion of an old statute, which had not (because it could not have) any reference to combinations of workmen; but in a trial for an alleged conspiracy, the judge *ruled* that it did apply to combinations of workmen. This ipse dixit became common law, and thenceforth convictions were had at this so called common law as often as it was proved in court that a combination existed. The statute so shamefully perverted is the 33d Edward I. A. D. 1305, and is entitled—"An Ordinance concerning Conspirators." It is as follows:—

"Conspirators be they that do confeder or bind themselves by oath, covenant, or other alliance, that every of them shall aid and (bear) [sustain the enterprize of] the other falsely and maliciously to indite (or cause to indite) [or cause to be indicted, or falsely to acquit people], or falsely to move or maintain pleas; and also such as cause children within age to appeal men of felony, whereby they are imprisoned and sore grieved; and such as maintain men in the country with liveries or fees for to maintain their malicious enterprizes [and to drown the truth], and this extendeth as well to the taken as to the given; and stewards and bailiffs of great lords, which, by their seignory, office, or power, undertake (to bear or maintain quarrels, pleas, or debates, that concern other parties) [to maintain or support pleas or quarrels for parties other] than such as touch the estate of their lords or themselves. This ordinance and final definition of conspirators was made and [finally] accorded by the king and his council [in his Parliament] the thirty-third year of his reign."

Were it not the constant practice of the courts to effect their objects in a multitude of cases by the perversion called common law, we might be surprised at finding this old statute made to include combinations of workmen to raise their wages, since it is clear that it was made long before any such combinations had existence, and that it related to matters wholly different. Such was, however, the perversion; and the punishments inflicted under this perversion were cruel in the extreme. As no penalty was named in the statute, the kind and quantity of punishment rested wholly with the judge; and such punishments and such vexations were inflicted and endured as would not be credited were they related.

The Combination Laws were, in practice, the cause of much suffering to the working people. In some few and small trades, workmen were kept in a state bordering on slavery; in others, there was perpetual warfare and frequent prosecutions. Many were the contrivances, by means of which workmen were seduced into a breach of the law, and then punished; and the consequence was, that workmen, in many cases, did all the mischief they could, by every means in their power, to their employers. Such was the law, and such were the practices under the law, at the time Mr. Hume undertook to use his best endeavours to get these laws repealed.

In Scotland, according to the evidence of Sir William Rae, Lord Advocate, given before the committee of the House of Commons, in 1824, "there were a variety of old Scotch acts of parliament which related to the regulation of wages, but none of them struck directly at combination.' The Scotch statute law before the Union did not make combinations of workmen a crime, the practice being unknown. The laws against combinations were understood not to include Scotland; but the supreme criminal court held that combinations of workmen to raise wages was a crime," and the courts ruled accordingly.

John Archibald Murray, Esq. Advocate, said distinctly, that "combination of workmen under the statute law of Scotland, was not a crime, but that such combinations had been held to be a crime by the decision of the supreme court for some years."

The statute laws of Scotland, like the statute laws of England, had many regulations respecting wages, and compelling people to work; these laws were unjust, harsh, and severe, but they were by no means so cruel as those of England. Scotland, until a late period, was almost wholly without any considerable manufactories; and in such employments as required a considerable number of workmen, there were other means to compel attention. In the fifteenth year of Geo. III. A. D. 1775, an act was passed, of which the following is the preamble:—"Whereas, by the statute law of Scotland, as explained by the judges of the courts of law there, many colliers, coal-bearers, and salters, are, in a state of slavery or bondage, bound to the collieries and salt-works for life, transferable with the collieries and salt-works when their original masters have no further use for them. And whereas the emancipating and setting free of the colliers, coal-bearers, and salters in Scotland, who are now in a state of servitude, gradually, and upon reasonable conditions, and the preventing others from coming into such a state of servitude, would be the means of increasing the number of colliers, coal-bearers, and salters, to the great benefit of the public, without doing any injury to the present masters, and would remove the reproach of allowing such a state of servitude to exist in a free country." Then follow the enactments. In the 39th year of George III. A. D. 1799, the matter was again brought before parliament, and another act was passed. The preamble of this act recites the act of the 15th of the king, and then adds—"Notwithstanding which, many colliers and coal-bearers still continue in a state of bondage from not having complied with the provisions, or from having become subject to the penalties of the said act." It then enacted certain matters to free them; and by section 10th declared, that "all laws relative to combinations of workmen to extend to colliers and persons employed in coal works."

In Ireland, where, until a comparatively late period, every thing relating to the people and their betters was done without law, at the will of those who had power in their local jurisdictions, we cannot expect to find many early legal restraints or regulations as to wages.

The first enactment on this subject was in the thirty-third year of Henry VIII. It empowered the justices to fix the rate of wages, to hear and determine complaints, and to fine and imprison those who demanded or took more than the fixed rate of wages. This act was revived by the 9th of Queen Elizabeth, and was again re-enacted by the 47th Geo. III. A. D. 1807.

From 1569 to 1707, no law appears on the Irish statute book respecting masters and servants. In that year, sixth of Anne, a statute was made in the Irish parliament, which directs, "servants being idle, negligent, or disorderly, the justices may cause them to be whipped, set in the stocks, and imprisoned for not more than ten days, and may compel them to serve again." This act contained many other regulations to compel workmen and servants to work as directed by law.

This act was further enforced by 2d George I. c. 17, A. D. 1715, and the power to flog refractory labourers was continued. In the reign of George II. restrictive punishments for combinations were first enacted; by first George II. c. 21, 1727, this was extended in 1729, and included all workmen, without any reservation. In 1743, an act was passed to prevent workmen meeting in clubs; severe penalties were enacted against the master of any house who knowingly permitted such meetings. By the 19th and 20th George III. A. D. 1780, the combination acts were made more general and more precise as to the acts which should constitute combinations of workmen, which it treated as a national evil. By the 27th George III. A. D. 1787, secret oaths, which appear to have been common among associated workmen, were forbidden.*

Many other acts were from time to time passed to regulate trade and to settle wages; very few of which were of any use, while most of them were oppressive and mischievous. What was the practice under these acts we are not well informed; but from what we know of Irish administration of justice, it may be safely affirmed, that their administration was such as was supposed would at the moment promote the interest of the masters, without much regard to its consequences in respect to the men. The laws were not worse than those of Scotland or England.

We shall now proceed to relate the efforts made to procure a repeal of the Combination Laws. A friend of Mr. Hume's, who for several years had turned his attention to the subject, and had carefully collected all the information he could, laid that information before Mr. Hume; and from that time, Mr. Hume, with his characteristic perseverance, pursued his object, and never quitted it till he had accomplished it.

The repeal of these laws was first brought before the public in the newspapers, in the year 1816, but the proposition was discountenanced by every body. Perseverance can, however, effect wonders. No opportunity was omitted, by means of the press and by conversations with influential individuals, to break down the prejudices by which alone these laws were maintained. In 1818 and 1819, a series of Essays on the Combination Laws, with a view to procuring their repeal, were published in a small weekly paper called the "*Gorgon*," which was regularly sent to many Members of Parliament, and other persons; and some notice of the subject was occasionally taken by several newspapers.

On the 19th of June, 1819, the business was first brought before the House of Commons by Mr. Hume, who presented a petition from a large number of workmen of London and Westminster, which prayed for a repeal of the laws against combinations of workmen. The prayer of the petition was supported by Mr. Ellice, Mr. Williams, and Lord Elrington. This was a considerable step, as it furnished a sort of basis on which to proceed. Several of the newspapers, which had hitherto rejected articles sent to them on the subject, now inserted those which from time to time were sent.

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* For a more detailed account of the laws relating to this subject in England, Scotland, and Ireland, see "A digest of all the Laws at present in existence respecting Masters and Work People. By George White. London. 1824."

In 1822, Mr. Hume was prepared to move for a committee on the subject, but it was thought the House of Commons were not as yet in a condition to entertain the question: the motion was therefore postponed. Much pains were now taken to obtain the concurrence of influential persons to the measure. Several of the leading newspapers took a decided part in recommending the repeal of these laws. In this good work the *Edinburgh Scotsman* stands conspicuous. The service which that ably-conducted paper rendered was of great importance. Mr. Hume, in the session of 1822, again mentioned the subject in the House of Commons, when he met with the countenance of Mr. Huskisson, Mr. Stuart Wortley, and Mr. Ricardo. These gentlemen were all, however, of opinion, that it would be better not to press the subject until the next session, by which time, it was concluded, the subject, since it had now attracted a considerable portion of attention, would be better understood; and Mr. Wortley and Mr. Ricardo both promised their assistance. Mr. Hume, therefore, consented to let the matter lie over until the next session. A curious circumstance now occurred. Some persons, who had been assisting Mr. Hume in some calculations, and knew the support he was likely to receive from both sides of the House, suggested, as it is asserted, to Mr. Peter Moore, the bringing in a bill at once to repeal the Combination Laws; and Mr. Moore having consented thereto, Mr. George White, a clerk of the House of Commons, undertook, at Mr. Moore's instance, to prepare a bill. In this he was assisted by Mr. Gravenor Henson, of Nottingham; and, on the 23d of April, Mr. Moore's bill was introduced and read a first time. The bill was a singular performance. It displayed great ability, but the matter it contained was not confined to the Combination Laws. It embraced also matters relating to arbitrations between masters and workmen—embezzlement of goods and tools—modes of hiring and paying, particularly as to payment in goods—and several other matters. Some of its enactments were absurd; some mischievous. These were the consequence of local and particular notions, but so much of the bill as related to the repeal of the several acts and parts of acts were perfect; and the few enactments which followed, and related only to the repeal of the Combination Laws, were remarkably well drawn, and afterwards became the basis of the bill which was passed in 1824. The bill, as it was introduced by Mr. Moore, in 1823, alarmed a great number of the Members, and it was therefore put off from time to time, and never went to a second reading.

Considerable efforts were now made, by some friends to the measure, to induce the working people to come forward and petition the House of Commons, but with very little effect. Some few—very few—persons agreed to petition, but the body of the working people were immoveable. They, as usual, had no confidence in any body, and but little sympathy with one another. It was a habit with them never to do any thing, even to serve themselves, unless some immediate and pressing necessity demanded it, and then none but those who felt the pressure ever exerted themselves; so that when Mr. Hume, on the 12th February, 1824, moved in the House of Commons, and obtained his committee, very few petitions had been promised, and but a small number of persons belonging to the working classes had volunteered to give evidence. When, however, the committee was appointed, and the working people saw that their cause was likely to undergo an investigation, a considerable number came forward, or were deputed to give evidence before the committee; but notwithstanding the number was in itself considerable, it was next to nothing when compared with the great body of people on whom the laws operated oppressively. Very few places sent delegates, and still fewer of the London trades gave themselves any trouble about the matter; so that it may be said they were served, and the greatest possible boon was conferred upon them, in spite of themselves. The consequences have not, however, been the less beneficial. A considerable and formidable opposition was made by some of the master manufacturers; but even among them the same supineness prevailed as among the men. The one class would not generally exert themselves to obtain the advantages held out to them, and the other class would not generally exert themselves to oppose what they dreaded as being fraught with vast evil to them. In this case, the wisdom lay almost wholly with those who promoted the repeal of the laws; scarcely at all with those for whose benefit the repeal was intended.

The first meeting of the committee was on the 17th Feb. 1824. Of this committee, Mr. Hume was the chairman; and he, as chairman, issued a circular note to the mayor, or other head officer, of forty of the principal cities and towns of the United Kingdom, requesting them to send to the committee such persons as were competent to give evidence on the business before the committee: the circular letter was also inserted in the public papers. This was an open, candid, fair, but unusual course: no man can say that notice enough was not given. The committee sat thirty-six days, and examined no less than 122 witnesses: these witnesses may be classed as follows, *viz.*

Members of Parliament,	3
Professional and other gentlemen,	8
Official gentlemen,	7
Master manufacturers,	60
Journeymen,	44
Total,	122

It should be observed, that the inquiries of the committee were also directed to the exportation of machinery and the emigration of artizans. But more than 100 of the witnesses were examined as to the effects of the combination laws. The committee sat for full three months, and examined every person who desired to be examined. This was an extraordinary instance of devotion in a committee of the House of Commons. This circumstance was not, however, the only extraordinary circumstance which attended the proceedings of this committee; it reported the minutes of evidence, from time to time, to the House of Commons; it made no less than six of these reports, each of which was printed with more than the usual despatch, and was very widely distributed; every man who had been, or was to be examined, might have had, and most of them, as well as many other men, and bodies of men, had copies. If, therefore, there ever was a committee which, more than another committee, demonstrated their desire for the fullest information; if ever one committee, more than any other, took the most impartial course, the praise of having done so belongs to this committee.

The business this committee occasioned was enormous; but Mr. Hume was found quite equal to it. His diligence never was exceeded, any more than the patience with which he attended to its duties by day and by night. He knew well the vast importance of the subject, and he knew also that nothing but the greatest vigilance and diligence could enable him to obtain the object he aimed at. A review of all the circumstances which attended this inquiry, and an account of the evidence received by the committee, would be both entertaining and instructive, but it would occupy too much space, and must therefore be omitted.

This committee was most important, interesting, and popular in the estimation of the wisest men in that house.—As usual, only twenty-one members were at first appointed; but such was the desire of many eminent members to attend and take part in a matter of so much consequence, that no less than twenty-seven were added thereto; and the committee consisted of forty-eight members. A fairer, a more intelligent, and a more attentive committee never sat: it was composed of men from both sides of the house, ministers, law-officers, gentlemen, merchants, and manufacturers.

It may fairly be said, that men of every party and of no party were members of it. The saints alone took no part in it; but at this no one who has observed their conduct will be surprised. They never have, on any occasion whatever, stood forward for the working people, except in matters of charity. They will attend meetings to raise money to distribute as mere charity, to be received humbly. They will establish and support soup shops, to deal out a miserable meal to the unfortunate people whose necessities compel them to accept the degrading boon; but they always eschew those things which tend to free the people from absurd and oppressive laws, or to promote any matter which is likely to elevate them in political importance. As usual, the people owe nothing to them, while to the ministerial party, as well as to their opponents, they are greatly indebted. Nothing is however due to those who, however praise-worthy their conduct with respect to the emancipation of negroes in slavery, seem to have no desire to emancipate the working people at home—to free them from the operation of unequal and oppressive laws.

The committee made no formal report, but they did what was much better;—they voted a number of resolutions, and brought in a bill founded on those resolutions. In this Mr. Hume acted with his accustomed good sense.—Had a report been drawn up, it must have been of considerable length; must have been discussed several times in the committee; would have been altered and modified to suit the notions of individuals; and consequently would, like but too many other reports, have been inconsistent and absurd; but the worst consequence would have been, that the bill could not have been passed in that session. Mr. Hume's sagacity enabled him to foresee and to prevent these evil consequences.

The bill, when brought into the house, contained the whole of the repealing clause, originally drawn by Mr. White, for Mr. Moore, and such was the ambiguity, complexity, and absurdity of the law as it stood, that the repealing clause recited no less than *forty-five* acts, or parts of acts, which it was necessary to repeal. It also contained a clause to prevent workmen from being again subjected to the fictions of the barbarous and unjust practice called common law. The bill was short, and was drawn with a view to prevent the interference of lawyers of every description in its execution; and this rare and novel circumstance in an act of parliament was completely produced. Lawyers were totally excluded; justice could not therefore be denied nor law perverted. Little has been said of this act, but it was an excellent specimen of good legislation.

It was late in the session before the bill could be introduced; and its best friends, and the best friends of the working people, fearing lest, if discussions were had upon the bill, such a delay might take place as would prevent its passing, resolved not to speak on the subject in any of its stages, and it is remarkable that not a single debate on the bill took place.

When the bill was sent to the Lords, it found an opponent in the Earl of Lauderdale. His Lordship approved of the principle of the bill, but he said it was beneath the dignity of the House of Peers to pass it until the evidence taken before the committee of the House of Commons had been reprinted by the Lords; and he threatened to say as much in that noble house. Thus the bill was on the point of being lost from mere etiquette, and was nearly given up as lost by its friends. After much persuasion had been used, Lord Lauderdale very reluctantly agreed not to propose the printing of the bill, and it passed the Lords as it had passed the Commons, and thus the whole of the laws which pressed heavily on a particular portion of the people, did them serious mischief in many ways, and prevented their improvement, while no good was done by them to any other class of persons, were all swept away.

It has been said that no thanks were due to the legislature for a mere act of justice; but when the spirit in which laws against the common people had always been made, when the rooted prejudices which taught men to believe that nothing but coercion could induce the working classes to be orderly; when we consider the multitude of interests the repeal of these laws was supposed to affect, the dislike and obloquy which was pretty plainly evinced on the part of almost all those who were not themselves workmen, and the countenance and support they were willing to give to those who might be opposed to a repeal of these laws, it is it difficult to conceive how too much praise can be bestowed on the legislature, which by removing such a heavy load, destroying so many and such various means of annoyance, discomfort, and degradation, did more for the working classes in this one act than had ever before been done for them since law and government first began.

One remarkable circumstance must not be passed over. It is this:—Whatever might have been the opinions of those who opposed the repeal of the laws against combinations of workmen, when they came before the committee, all of them, with the exception only of two, upon being questioned, were constrained to confess that these laws were of no service to them. Almost all of them confessed, that they were pernicious; and ONE only desired their continuance. Thus the general principle which had been contended for by those who were opprobriously called *theorists*, was confirmed by practical men, who had, if any body could have, an interest in their continuance in the statute book.

The operation of the laws against combinations of workmen had (as has been before observed) drawn off the attention of the working people from all other causes of low wages, and had induced them to conclude that the sole cause was the law. This was declared by their delegates repeatedly during the session of 1824, and it was foreseen that this persuasion would remain until experience had convinced them, that however troublesome and unjust those laws might be, and however much they put the workmen in the power of their employers; and however they might be vexed, and prosecuted, and imprisoned under them, the laws were not, except in some very few cases, the cause of low wages. This could only be ascertained by attempts to raise wages after the laws had been repealed; and those attempts were made pretty generally as soon as the workmen found themselves at liberty to act openly. The attempt, however, to cause an advance of wages would not have been so sudden nor so general, had it not been promoted by two other causes operating at the same time; these were, a great increase of employment in every branch of business, and a great increase also in the price of provisions. Combinations have always existed, and have very frequently been much more mischievous and vexatious before the passing of Mr. Hume's bill, than since the passing of his bill, and had the law remained as it was, not only would the simultaneous rise in the price of provisions, and the increase of business, have induced the workmen to demand higher wages, but would have compelled them to resort to means to accomplish their end much more obnoxious than those which they took. It enabled workmen to meet openly and avow their purpose; it brought the question, what is the real cause of low wages? to issue; and is rapidly convincing the great body of operatives, that it was not the law which in this respect degraded and distressed them; and this knowledge, when it shall become general, will put an end to many of those annoyances which have long existed, and produced great mischief as well to employers as to those employed. This is undoubtedly a great good, and as such it must have been viewed by the committee of the House of Commons, which sat in the last session "to inquire into the effects of the act 5th George IV. c. 95, (commonly called Mr. Hume's bill,) in respect to the conduct of workmen; and to report their opinion how far it may be necessary to repeal or amend the said act."

It is well known that the committee which sat in 1825 was the consequence of representations made to Government by some ship-owners, ship-builders, and manufacturers. The representations they made, and the fears they expressed, induced Mr. Huskisson, Mr. Peel, and Mr. Wallace, to lay aside the true character of legislators, and to become practical statesmen—the most absurd of all characters for men in their situation to assume. Mr. Huskisson, in moving for the committee, and Mr. Peel, in supporting him, made speeches which every man who has any thing like a competent knowledge of legislation must wish had never been spoken—in which wish those gentlemen themselves must now concur. This committee was, in many respects, the reverse of the committee of 1824. It was not at first intended to examine more than a few of those who had made complaints, and had so strangely misled several of the best informed and most popular of the ministers. The propositions made by the ship-builders were, that workmen should not be permitted to associate, or to subscribe money under any pretence whatsoever, unless they first obtained permission of the local magistrates, and unless some one of these magistrates consented to become treasurer and to see how the money was disposed of. Another proposition was, that they should again be liable to prosecution at what was called the common law. Great fears were reasonably entertained that the gentlemen before named had so far been imposed upon, and had so far forgotten themselves as to have acceded to these propositions, which, could they have been incorporated in an act of parliament, would at once have reduced the whole of the working people to a state of slavery, and would have injured the community to an almost inconceivable extent.

The committee, when appointed, consisted of twenty-one gentlemen. It was not, as is usual in such cases, a revival of the former committee, but a new committee, in which the most active and useful members of the old committee were not included. It was absolutely necessary to put Mr. Hume on the committee, and he was a host for the working people. Great exertions were made out of doors. The people were alarmed, and came forward with much more alacrity than on the former occasion. Mr. Hume was indefatigable to serve them; he was well supported, and his labour was as much as possible diminished by the exertions of friends out of doors. In the committee he stood alone. A large number of petitions were presented to the House of Commons praying to be heard before the committee. These were referred to the committee; and the petitioners very generally, or their deputies for them, unto Mr. Wallace, the chairman of the committee, requesting to be examined. With great difficulty a very few of these persons got before the committee, and were examined; and the printed minutes of evidence show, that in every case in which the workmen were examined, the charges which had been made against them by their employers were shown to be either frivolous, or of very little importance in fact. Every one of the cases brought before the committee by the masters broke down completely, upon investigation.

At length a report was made, which will bear no comparison with the resolutions of the former committee, and a bill was brought in to repeal Mr. Hume's bill. This bill varied in but few particulars from Mr. Hume's bill, and in what it did differ it made what was clear somewhat obscure; and was therefore so far a worse law than that which it repealed. It has been remarked, in that very important book which has just been published, the "Parliamentary History and Review," that "the second act differs so slightly from the first, that it is difficult to account for the acrimony with which the debates which accompanied it were conducted. One cannot see why the advocates of the second act should have attacked Mr. Hume with such asperity, nor why those who voted for the first act should so strenuously have opposed the second." But the reports of the debates, as they appeared in the newspapers, do by no means show the acrimony and personalities which the ministerial side of the house displayed towards their opponents. Very little, indeed, of what passed ever appeared in print; and a person must have been in the house to have believed it possible that such things could have taken place as did take place on those occasions. Several persons well acquainted with the conduct of the house, expressed their surprise at what was passing.

But the second bill became the law. It is somewhat more vague than the first bill; punishment has been a little extended, and the power of the magistrate has been a little increased; but the bill is substantially Mr. Hume's bill, and is a complete emancipation of the working people from the laws which oppressed them. It has been made the bill of the ministers; and the repeal of the obnoxious laws may now be fairly considered as the unqualified act of all parties, and of almost every individual in both houses of parliament.

It was very much feared by the workmen in many places, that the matter would be again brought forward in the present parliament, with a view to some alteration of the act to coerce the workmen; but the great strikes, so long continued and supported as they were by unusual means, terminating as they did, showed that even such proceedings were comparatively harmless, while they were conducted openly, and by the most discreet among the workmen. It proved to all reasonable men, of whatever class or description, that wages did not depend as to their amount on acts of parliament. This question may, therefore, be considered as set at rest, and not likely ever again to be revived.

All error is pernicious, but none perhaps more so than those which are sometimes adopted by the working people, and are acted upon by them, since all the evil which results falls upon themselves; they are the sufferers in all such cases, and he is their best friend who endeavours to remove their errors. The notion that a man may pay as high wages as he pleases, and charge whatever he pleases for his commodities or manufactures, is wearing away; and it is the bounden duty of those among the working people who understand the principles which regulate wages and profits, to enlighten their fellow-workmen in these, to them the most important of all important subjects. Workmen know well enough that when commodities are plentiful, they are cheaper than when they are scarce, and they should also know that it is the same with labour. Labour is the only commodity the workmen has to dispose of; and if the number of workmen be greater than there is employment for, that is, if there are plenty of workmen, wages will be low; and if, on the contrary, workmen are scarce, and work is in plenty, wages will be high. The commodity called labour is regulated in the same manner as goods and produce are in the market, and like them, varies in value as it is plentiful or scarce. One of the very best friends of the working people, notwithstanding they have been persuaded that he is their enemy, has most truly observed, "*that a market overstocked with labour, and an ample remuneration to each labourer, are objects perfectly incompatible with each other.* In the annals of the world they never existed together; and to couple them, even in imagination, betrays a gross ignorance of the first principles of political economy."*

Workmen should cease to condemn their employers for endeavouring to procure their labour for the least possible sum. All trading is governed by the desire "*to buy as cheap, and to sell as dear as possible,*" and this, of course, extends to labour—it is practised by every labourer in his own case. If he desires to purchase any thing, he endeavours to give as little as he possibly can for it; if he wants any one to assist him, he gives the smallest sum he can for the labour of the man who assists him. This has always been the case, and always will be the case as long as trading, and manufacturing, and cultivating the earth continue. But workmen should, above all things, be taught this most important fact, that it is not the employers, but the workmen themselves who fix the price of labour: it is they who undersell and reduce their own wages. It would be quite useless—nay, absurd, for a master to offer low wages to the men he wished to employ, if hands were scarce, and all the workmen were already employed. It is quite certain that for him to induce the men to leave their employer and come to him, he must not offer lower wages, but higher wages; while, on the contrary, if all the masters are supplied with hands, and a number remain without employment, those out of employment would be insane if they were to request the masters to turn off their workmen, and take on those who were unemployed at higher wages than he was then paying. They never were so mad as to propose this. What they have always done, and what they always will do in such cases, is this,—the unemployed men will either offer to work for less wages than those in employment are receiving, or those in employment will consent to take less wages to keep their employment, and prevent those who are unemployed from exchanging places with them. Thus it is that wages are regulated by the workmen themselves, and not by their employers. It behoves every workman to reflect seriously on those things; to ask himself, not whether it will be agreeable to him to come to this conclusion, but whether or no it be not the truth. But then the remedy: how, he will say, is this to be remedied? The answer is, in one way only, by ceasing to produce workmen faster than employment can be found for them. There is no other remedy for low wages and all its evils; and whoever pretends that a remedy can be found in any other way is either a deceiver or is deceived himself. Nothing but restriction as to numbers can ever cause a permanent rise of wages, and if this be not done, bad wages, poverty, and ignorance, must be the lot of the working people. Such has, however, been the good consequences of the little school learning which has been obtained by considerable bodies of the working people within the last few years, that notwithstanding their real wages have generally declined, their knowledge has increased, and with their knowledge their prudence. They are better clothed, and more sober than they were some years ago; and if they would but show a marked repugnance to those among them who are addicted to that most destructive of all vices, drunkenness—if they would expel from their company, and wholly cease to associate with those drunkards, whose conduct brings disgrace upon the whole body of them—if they would persevere to the utmost to keep their own persons decent, and practice a respectful, yet bold and manly conduct—if they would exert themselves, and use all the means in their power to procure the best possible education for their children—and, finally, if they would attend to that by far the most of all important matters, preventing the too rapid increase of their number, it is not possible to say to what a state of comfort and consequence they might in a few years attain. For the power they now possess to meet freely, and the means opened thereby for the improvement of their understandings, and consequently of their condition, they are permanently indebted to Mr. Hume.

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* Malthus' Essay on Population.

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> "Bids bashful merit stand confessed;
> And like coarse metal from the mines,
> Collects, irradiates, and refines."—*Moore.*

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INSTRUMENT FOR TRACING FLOWERS FROM THE SKETCH ON DESIGN PAPER.—Invented by Mr. Andrew Baldrence, Paisley.

Fig. 3.

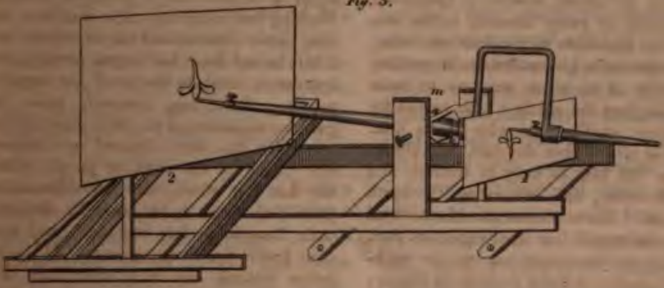


Fig. 2.

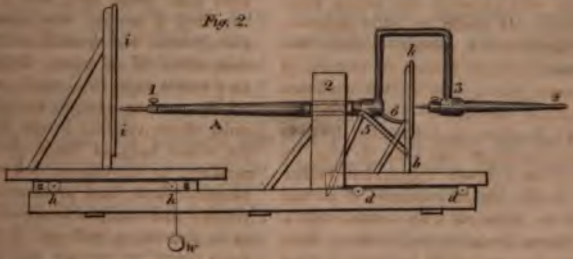
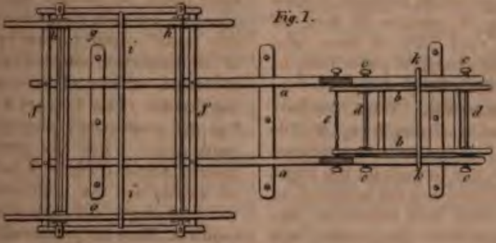


Fig. 1.



Swan Sc.

INSTRUMENT FOR TRACING FLOWERS FROM THE SKETCH ON DESIGN PAPER.

Invented by Mr. ANDREW BALDRENCE, Paisley.

[Communicated by the Inventor.]

HAVING been employed in figured work of various kinds, and having often found it difficult as well as expensive to get the designs of the drawer transferred to design paper, for reeding off the flowers, my attention was turned to the subject, and I became desirous, if possible, to contrive a certain and correct mode of doing it. This I have with much expense and labour effected. By the instrument which I have invented, however complicated the design, a person quite unacquainted with drawing may copy any design with more certainty, in less time, and with less expense than by any former method; and the patterns may be either enlarged or diminished to any degree required. I hope the following description, with the accompanying drawings, will sufficiently explain the nature of this invention.

Description.

Fig. 1 of the plate is a plan of the framing and other apparatus belonging to the machine. *a*, *a*, the under part of the framing, having three cross-bars screwed to the under part of the long side-pieces, and by which they are fixed down to a table or other framing of a convenient height; *b*, *b*, is a small moveable frame, made to run easily upon the rollers, *d*, *d*, and connected together by two small shafts, having small centres turning in the points of the screws, *c*, *c*, *c*, *c*, by which they can be shifted a little, as may be necessary. At *k*, *k*, a board is placed to which the design is fixed when the machine is to be used. C is a kind of spring which may be made of catgut, twine, or wire, being fixed to the points of the pins that go through the under frame, and fitted stiffly into their holes, so that they can be turned either to the right or left, to tighten or slacken the springs as may be wished.—Their use is to keep the design up to the point of the tracer, which will be better seen in fig. 2.

f, *f*, is a frame fitted across the under one, having friction rollers at *h*, *h*. These rollers are connected with shafts to prevent one end turning without the other; and there is a small slide at the end of each, having a small friction-wheel fixed to the inner end, which works against the sides of the moveable frame to prevent side-shake, and also to shift it a little; *g*, *g*, the sides of the upper frame upon which the board is fixed that holds the design paper. There is a line fixed to this frame, going over a small groove, turned in the rollers, for keeping the board and paper up against the tracer.

Fig. 2 is a side view of the machine; the same letters refer to the same parts; the pullies or wheels, at *h* and *d*, are in the inside of the under frame, but are represented with dots, and, to avoid confusion, the screws are not represented. The lever, A, consists of a piece of clean straight grained mahogany, or any other wood that is not apt to warp, having a strong iron crank fixed near the middle, to allow freedom for the various motions necessary. 1 is the point where the tracer is fixed, being made to slide out and in six or eight inches, and fastened with a screw; 2 is an upright cheek, having a sliding piece inside, which can be regulated with two nuts; 3 is the iron crank, having an eye at each end into which the wooden handle is fixed; 4 is the handle; 5 is an apparatus for shifting the board, the lower end being fastened into the cord described in fig. 1, at *e*, and similar to the cord for tightening a bow-saw. It has a joint at 5, and another where it is fixed to the board; 6 is a bent piece of iron fixed to the board, and going through the upright frame, there being a hinge at the top of the board at *k*, the use of which is to give the board any angle which may be wanted, in order to reduce the breadth of the pattern. At *i*, *i*, the large board is fixed and is kept up against the tracer by the weight, W. Fig. 3 is a perspective view of the same, in order to show the manner in which the tracers act upon the boards; the flower or pattern is to be fixed on the board, 1, and the design paper upon 2, when, by moving the tracer of 1, it will make a similar figure on 2, and larger in proportion as the distance of the tracers from the centre. At *m* is the centre for the lever to turn upon; it turns upon two centre points fitted into the cross piece, and turning in the points of the screws that go through the cheeks. At top and bottom of the cross piece are two screws with centre points, that go into a sliding piece of iron, fitted to the lever, which being moveable, but fastened at any place with a screw, it is necessary that this joint have sufficient play to range the size of the drawing, and also that it do so without shaking.

The machine being thus prepared, the drawing, or flower, to be copied is placed on the board, 1, and a sheet of design paper put upon 2, fastened with pins or in any other manner. A piece of paper is put over the design paper, having the side next the design paper rubbed over with any dry colouring substance, and as the tracer at 1 describes the figures upon the drawing, so the tracer of 2 describes a similar figure upon the paper, and by pressing the colouring substance against the design paper, leaves a mark sufficiently distinct. By shifting the tracers out or in, and altering the centre of the lever, the copy may be made of any size that is wanted. The tracers are made of bone, horn, or ivory.

I am, yours, &c.

ANDREW BALDRENCE.

PREJUDICES AGAINST IMPROVEMENTS.

THERE is a certain prejudice against any new method of working, though more expeditious, and though it should produce the effect in as great perfection. This prejudice is the effect of habit, and can seldom be eradicated from the minds of such individuals as consider the ready occurrence of a proposition as a test of its truth. To establish a new philosophical theory, has, in every instance, required time sufficient to educate an entire generation of men. The rejection of the Aristotelian philosophy, the adoption of experimental research, the substitution of the doctrine of gravitation instead of Descartes' Vortices, and the rejection of phlogiston by our contemporaries, are sufficient illustrations of this assertion. New practices are still more difficult to be introduced. The new grammar, the new rudiments of science, or the new instruments, however superior to the old in simplicity, facility, and truth, must be less valuable to the ordinary teacher or artizan, whose memory is familiarized with the precepts of the latter, and whose only ambition is to earn his subsistence with the least possible exertion. However, the consideration that there is but a small chance for the general introduction of any new machine or improvement, ought not to keep it from the public, whilst it is considered as an improvement. There are always those whose minds are unfettered by prejudice, and to whom any hint tending to produce an improvement always proves acceptable.

Superseding the labour of the poor by the extension of machinery, and the application of inanimate first movers, has been by some reckoned cruel, and even unpolitical. It is stated by certain humane but mistaken objectors, that the scheme of mechanical and chemical improvements is pointed against the human species, and tends to drive them out of the system of beneficial employment. Two creatures offer themselves to me for employment and support—a man and a horse. I must invariably prefer the latter, and leave the former to starve. Two other beings—a horse and a steam engine, are candidates for my favour. My preference to the latter tends to exterminate the species of the former. In both cases it is stated that the number of intelligent creatures capable of the enjoyment of happiness must be diminished for want of support; and that, on the whole, the sum of the proposed improvements is not only a less proportion of good to society, but a positive accession of unemployed poor.

On this wide and extended argument, which can in fact be maintained against improvements in no other way than by insisting, that the savage state, with all its wants, its ignorance, its ferocity, and its privations, is preferable to the social intercourse of effort and division of labour we are habituated to prefer, it may be sufficient to observe, that the topic includes matter, not only for reason and induction, but also for experiment. By reference to the matter of fact, though it must be allowed that new improvements, which change the habits of the poor, must, at first, expose them to temporary inconvenience and distress, against which, in fairness, it is the duty of society to defend them; yet the invariable results of such improvements is to better the condition of mankind. The nations which have shown the most ingenuity and industry in this way, are not only the richest, the most populous, the most intelligent, and the best defended, but the provinces of those nations are seen to flourish in proportion to their respective degrees of activity in this respect. And from these exertions it is, as Smith emphatically remarks, that "the accommodation of an European prince does not always so much exceed that of an industrious and frugal peasant, as the accommodation of the latter exceeds that of many an African king, the absolute master of the lives and liberties of ten thousand naked savages."

PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE.

[Concluded from page 23 of the present Volume.]

If in any case it should become necessary to represent a circle, which does not lie in an isometrical plane, we may observe that the major axis will be the same in whatever plane it lies; and it will be the picture of that diameter, which is the intersection of the circle with the plane parallel to the picture, passing through its centre. And the major axis will bear to the minor axis the proportion of radius to the sine of the inclination of the line of sight to the plane of the circle. We may observe further, that the diameters of the ellipse, which are to the major axis, as $\sqrt{2}$ to $\sqrt{3}$, when such exist, are isometrical lines.*

And the representation of every other line parallel, and equal to any diameter of the circle, may be exhibited by drawing it equal and parallel to the corresponding diameter in the ellipse. If it should be desired to divide the circumference of an ellipse into degrees, or any number of parts representing given divisions of the circle, it may be done by the following method:—

Let an ellipse be drawn, fig. 6, No. CXV. and on its major axis, A, G, a circle described, with its circumference divided into degrees or parts in any desired proportion, at B, C, D, E, F, &c. from which points draw perpendiculars to the major axis. They will cut the periphery of the ellipse in corresponding points. It would be difficult, however, in this way, to mark, with sufficient accuracy, the degrees, which lie near the extremities of the major axis. But the defect may be supplied by transferring those degrees in a similar way, from a graduated circle, described on the minor axis. In this manner an isometrical ellipse may be formed into an isometrical circular instrument, or an isometrical compass, which may show bearings or measure angles on the picture, in the same manner as a real compass or circular instrument would do in nature.

It may be often useful to have a scale to measure distances, not only in the isometrical directions, but in others also. And this may be done by a series of similar concentric ellipses, as in fig. 7, No. CXV. dividing the isometrical diameters into equal portions. The other diameters will be so divided as to serve for a scale for all lines parallel to them respectively.

Thus, in the isometrical squares, exhibited in fig. 2, distances measured on the longer diagonal, or its parallels, would be measured by the divisions on the major axis, those depending on the shorter diagonal by the divisions on the minor axis.

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* We may remark, that if a cone be described, having its vertex at C, which lies in the line of sight, fig. 2, No. CXV. and passing through the three radii, C, B, C, E, C, G, all the straight lines in the superfices of that cone passing through C, and all other lines parallel to any of them, are isometrical, as well as those parallel to the three principal isometrical lines, C, B, C, E, C, G; and no other lines but these can be on the same scale. But though these multiply the number of isometrical lines infinitely, it is of little practical use, because it is only those which are parallel to the three principal lines, that can be easily distinguished at sight, to be isometrical.

We may further remark, that if a line be drawn through the point, C, parallel to any given line whatever, and that line be made to revolve round the line of sight, at the same angular distance from it, so as to describe the surface of a cone, all other lines parallel to it, in any of its positions, will be isometrical, as they respect one another.

To describe a cylinder lying in an isometrical direction, the circles at its extremities should be represented by the proper isometrical ellipses, and two lines touching both should be drawn; and in a similar way, a cone, or frustum of a cone, may be described. A globe is represented by a circle, whose radius is the semi-major axis of the ellipse representing a great circle.

It would not be difficult to devise rules for the representation of many other forms which might occur in objects to be represented. But the above cases are sufficient to include almost every thing which occurs in the representation of models, of machines, of philosophical instruments, and, indeed, of almost any regular production of art.

Buildings may be exhibited by this perspective as correctly, in point of measurement, as by plans and elevations, under the advantage of having the full effect of a picture.

A bridge, or any circular or gothic arch, consisting of portions of circles lying in isometrical planes, may be represented by portions of isometrical ellipses, which will easily be adapted and drawn upon the principles already explained, by which wheels are exhibited on their axles. The centres of those circles must be found with which the centres of the ellipses must be made to coincide, their minor axes lying along the lines drawn from those centres perpendicular to the planes of the circles. The shaft of a pillar consists of a frustum of a cone and a cylinder united; or perhaps of a cylinder alone, or a congeries of cylinders; and we have already shown the method of exhibiting these, as well as their bases. And on the same principles, the position and size of the volutes and ornaments of the capital may be found, and such guiding points as will make it easy to trace their forms. Thus the different courts and edifices of a cathedral, a college, or a palace, may be correctly depicted; and even the rooms and internal structure, though less in the form of a picture, may be exhibited in such a way as to enable an architect, or his employer, to contemplate their situation, their ornaments, furniture, or any other circumstance belonging to their appearance, and to mark down exactly what he would have done, in such a way as could hardly be misunderstood by an attentive agent, though at a distance.

But in thus exhibiting buildings as transparent, and their interior laid open, there is a danger of being confused by a multiplicity of lines, which is a difficulty in a building containing many rooms, that would need some address to get over. It is better adapted to exhibit the inside of a single room; of a cathedral, for instance, the aisles and transepts of which would not cause any great perplexity.

In the same manner a plan of a city might be given, which would not only represent its streets and squares, as well (by the help of the scale above described, fig. 7, No. CXV.) as a common plan, but also a picture of its churches and public buildings, and even its private houses, if such were the design contemplated by the artist, as they would almost all become visible when looked down upon from the commanding height which this perspective supposes. And such a single exhibition, if well executed, might give a better idea of a distant capital than a volume of description.

In the instances which have been given, most of the lines are isometrical. But the art is applicable to many cases, where there are few or none such. It may be necessary, in many of them, to draw isometrical lines, or isometrical ellipses, by way of a guide, to determine the position of certain lines and points to enable the artist to describe with accuracy what he has in view. And there is scarce any form so anomalous as to preclude the artist from taking advantage of these methods of ascertaining such lines or points in it as will give him much assistance in representing it with precision. If the intention be merely to make a picture, the guiding lines may be obliterated as soon as they have served the purpose designed, or they may be retained in some cases, and their lengths or diameters noted down in figures, if it be wished, to give ready information. And often, if the artist wishes to provide materials to enable him at his leisure to give accurate descriptions or exact drawings, the rudest exhibition of such lines may completely serve his purpose, provided he notes down on the spot such measurements with accuracy, however unexact the lines may be on which they are recorded. In many cases it may be expedient to take liberties with this perspective, or with the picture, which will make it suit the purpose designed. And this will produce no confusion, provided those liberties are explained: for instance, it may often be expedient to make the scale in the vertical direction larger, sometimes very considerably so, than in the horizontal. It may, in some cases, be necessary to represent on paper what is hid in nature. What has been said on the internal structure of buildings is an instance of this as well as what we shall observe on the exhibition of subterraneous objects. We shall proceed to give some examples of these observations.

To give such a representation of an Etruscan vase as would enable an artist to model it exactly, would be exceedingly easy. Let a vertical line be drawn to represent the axis of the vase, fig. 8, No. CXV., and let points be taken in that axis, corresponding to the centres of the principal circles of the vase; through which the horizontal isometrical lines may be drawn representing the radii of those circles, by the help of which the isometrical ellipses representing them are easily drawn. These will become a complete guide to the artist. He may assist himself by looking at the object along the line of sight, and then, if he has any skill in drawing, he will find no difficulty in tracing the outline from one of these to the other, with sufficient correctness. If he is unskilled in the art, of course he must be at the trouble of finding a larger number of ellipses to guide him. And in a similar manner, any solid formed by the revolution of a plane figure round one of its sides may be represented.

The laying down the timbers of a ship, or making a picture of one, shall be another example.

Let a vertical isometrical plane be conceived to pass through its keel, and to be intersected by the perpendicular planes passing through the ribs, and by planes parallel to the decks. The isometrical lines, which are the intersections of these, may be measured in the ship, and represented with their proper measures noted down in the picture, which will afford the means of representing the ribs, and laying them down in their proper places.

If this should be designed for the purpose of constructing a ship from a given model, it might be sufficient to represent the ribs only on one side; those on the other side being the exact counterparts.

If the purpose should be to make use of these lines for a drawing, they need be marked but very faintly, and the artist will have little difficulty when guided by them to fill up the representation by hand.

A regular fortification, which we will suppose to have eight bastions, will afford another example.

A person not conversant in such a subject, is in general puzzled with plans and sections, and has very little idea of what is meant to be conveyed.

But he would easily understand it if he should see every thing exhibited in a correct picture, especially where he has the view of his object varied, as in a fortification, such has been proposed. Let an isometrical ellipse be drawn expressing the internal circumference of the place; and another concentric one, which marks the salient angles of the fortification on the principles already explained. Draw other guiding lines to every necessary point; the lines of the fortification may be easily transferred from a common plan to the isometrical, by the help of the scale of concentric ellipses described above, fig. 7, No. CXV., which will serve also to lay down the length of the bastions and curtains, &c. in whatever direction they lie. Find the elevations of every part on the isometrical scale; and thus the body of the place, the ditches, counterscarp, covered way, glacis, ravellins, and all the outworks, will be represented to the eye as they appear in reality, and in every varied position, with the advantage of having all the admeasurements laid down with geometrical precision.

If the artist should think the vertical lines in such an exhibition too small to give a correct idea of all the minute elevations, there would be no harm in his increasing the scale in that dimension in any desired proportion.

The face of a hilly or mountainous country like Switzerland, or the district of the lakes in the north part of England, will afford another example.

Isometrical horizontal lines may be drawn representing lines in the level from which the height of the mountains is to be reckoned, so that vertical lines drawn from the summits of the mountains may meet them, on which the heights may be marked, as well as recorded in figures, if required. And the mountains themselves may be drawn in their topographical situation. Their bearings may be marked by the help of the isometrical compass described in page 22, No. CXVI. It would be easy to transfer them from a common map to the isometrical plan; and thus the face of the country might be represented just as it would appear from the commanding height which the isometrical perspective supposes.

Yet, as the slopes of hills and mountains are seldom so steep as the line of sight, it might sometimes suit the purpose to represent the height of elevations as twice or three times the reality, in order that mountains might project an outline on the plane behind; otherwise the summit might be projected on the mountain itself, which would, in a degree, destroy the effect of a picture.

This art might be advantageously employed, also, for tracing what is below the surface of the earth, as well as what is above it. It may be applied to geological purposes, and give not only the order of the strata, but their variations and their geographical situations. And for this purpose it might be useful to increase the vertical scale, in a great proportion, above the horizontal. It would be easy to mark the dip or rise of the strata, as well as of the earth above them; to represent their various disruptions; to show the situation and extent of fissures and metallic veins; to mark the boundaries where the upper strata have been swallowed up, or cease to appear, or where the under strata push up towards the day. It would be easy to mark the variations in the thickness of the strata in different places, and to record the result of experiments made at any point, by boring or sinking shafts, which might be done by drawing a vertical line downward, so as to represent the thickness of the laminæ, which might be marked by different colours. By such a method, the geologist might obtain a map of the country, which might exhibit, at one view, the general results of all the experiments and inquiries that had been made relative to that science. And the owner of an estate might record, in a small compass, all that is known respecting its minerals, and be able, from a comprehensive view of them all, to judge of the probability of success in sinking a shaft, or driving a level. He might also make good use of this perspective in tracing his shafts and drifts in all their windings, elevations, and depressions, and comparing them with the surface above, marking also the veins and strata in which they run. For if the artist knows what is beneath the surface, he has no difficulty in representing it as transparent. He must be careful, however, not to perplex himself by lines too much multiplied, and take advantage of his being able to paint the lines with different colours, for the purposes of distinction; and he must use a considerable address in throwing out such lines as would be of little use, and retaining such as will produce the effect of a picture, which should be well preserved, in order to make the exhibition easily intelligible.

If he should wish to make a drawing of minerals or crystals, this perspective would be well suited to the purpose.

The point, however, on which the writer of this paper can speak with the greatest confidence, is on the representation of machines and philosophical instruments; having been himself so much in the habit of practically applying to them the principles that have been detailed; and this he has exemplified in the plates.

The correct exhibition of objects would be much facilitated by the use of this perspective, even in the hands of a person who is but little acquainted with the art of drawing; and the information given by such drawings is much more definite and precise than that obtained by the usual methods, and better fitted to direct a workman in execution.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, Teacher of Mathematics, Glasgow.

No. II.

In every age and country where learning has prevailed, the mathematical sciences have been esteemed as forming an extensive and valuable part of human knowledge. Their influence on the mind, independent of their practical utility in life, is alone sufficient to place them on a level with most other studies. They accustom the mind to attention. In the pursuit of this study, we are delighted with a succession of connected truths, which are evident when we understand the reasoning, but which do not appear at first sight to depend on each other. The pursuit of truth gratifies a faculty implanted in us, as much as the pleasing of our senses; and the pleasure which we by that means derive, is free from the regret, the turpitude, and the intemperance which often attend sensual pleasures. When any one has felt pleasure, he will naturally wish for a repetition of it; but this he cannot have, unless he understands the reasoning by which any thing is shown to be true; and as mathematical truths are not obvious, he will be incited to study the reasoning by which any conclusion is aimed at. Attention is requisite for this purpose; and by endeavouring to attend closely to one subject, a habit of attention will soon be established.

By mathematical knowledge we acquire a habit of clear, demonstrative, and methodical reasoning. If we look into controversial writing, hear verbal disputes, or examine the foundations of many ingenious systems, we shall be surprised what superficial reasonings satisfy the greatest part of mankind. The method of convincing which is often adopted, is to work upon the passions, rather than the judgment. A piece of wit, an anecdote, or a simile, is often advanced in place of solid sense. You may hear a subject, abundantly plain, obscured by reasoning the most foolish; and often you may see a man of plain common sense supporting a position, which scarce requires proof, silenced by the noise or the laugh of his opponent, or knocked down by a quotation from Shakspear or Hudibras. If with this we compare the reasoning of the geometrician, we shall find it is conducted in a manner diametrically the reverse.

From a few simple axioms and self-evident principles, we proceed gradually to the most general propositions and remote analogies; deducing one truth from those already known, in a chain of reasoning infallibly connected and logically pursued, and truth agreeably forces itself upon the mind, in the full tide of irresistible conviction.

By an attachment to these studies, we acquire an elevation of thought which fixes the mind, and prepares it for other pursuits; we follow with pleasure the same closeness of argument in other researches; and if we find a want of this accuracy, our mind, accustomed to the contemplation of truth undisguised, revolts indignant from the merely probable, the false or erroneous assertion, and reason disdains to assent to the sophisticated tale.

It is true, indeed, that in most other subjects, the same strictness of reasoning is impracticable, because their principles do not admit of the same degree of evidence; but still it is imitable in a certain degree. For proof of this I need only appeal to those works, the authors of which were mathematically inclined. Of these I shall only notice Smith's Wealth of Nations, Reid's Essays on the Powers of Man, and the writings of Dr. Beattie.

What has been said may recommend mathematics as a useful exercise to the mind; as exercising our mental powers is as necessary for giving a vigorous constitution of mind, as bodily exercise is for procuring health and strength to our frame. But it is not merely in a speculative view that the study of mathematics is advantageous; their application to other sciences and the arts, have given rise to many inventions, which are useful in every department of life.

The importance of mathematics as a preparation for other sciences, will be evident on considering their connection and dependence on mathematical principles. We may observe, that all the objects of our knowledge are made in number, weight, and measure, and therefore to consider them we ought to understand arithmetic, geometry, and statics; and the greater advances we make in those arts, we are the more capable of considering such things as are the ordinary objects of our conceptions. But particularly we now know, with astonishing precision, the courses, periods, order, distances, and proportions of the several great bodies which compose our planetary system, at least of such as are within our view; and this affords a remarkable instance of the power of arithmetic and geometry well applied. Let us suppose ourselves placed at that stage of society, when the long course of observation and study necessary to bring astronomy to its present perfection, had yet to begin;—let us suppose ourselves ignorant of the most obvious revolutions and motions of our planet;—let us suppose ourselves ignorant of its periods and seasons, without instruments to make observations, without any idea of observations or instruments;—when would we expect that any of our posterity should arrive at the art of predicting an eclipse? When would we suppose them capable of reckoning all the eclipses past or to come, for any number of years? When would we suppose that if conveyed to any distance from their home, that they should be able to tell how far from it they were south, north, east, or west, or what course to take to return? We know that all this may be done, and is daily done, by what is known in astronomy; yet, when we consider the vast industry, sagacity, and multitude of observations necessary for these purposes, we would be inclined to give up the pursuit as impossible to be attained; but by the assistance of the mathematical sciences, these things are now rendered so easy, that they may be performed by ordinary understandings.

What has been said of astronomy is equally true of geography and of navigation, sciences which depend upon astronomical and mathematical principles. To chronology these sciences are equally necessary; from the circumstances of the relation of many parts of ancient history, the precise dates have often been ascertained when some remarkable events have taken place. Thus Mr. Halley determined the day and hour of Julius Cæsar's landing in Britain; and the accounts of ancient eclipses have by this means enabled us to tell exactly the dates of some events in history, which, without this verification, might be reckoned fabulous. Thus, in order to read history with advantage, some knowledge of geography and chronology are necessary.

Light is a considerable object of natural knowledge; but all inquiries concerning this body are frivolous and futile, unless guided by geometry. I am not to be understood here as speaking of the ingenious theories of the chemists concerning this wonderful substance —with these the geometers have nothing to do; but they have discovered two of the principal laws of its action, *viz.* in the reflection and refraction of its beams, and have invented the beautiful theory of optics, and of reflected and refracted vision, and have taught us to manage this subtile body, for the improvement of our knowledge, and useful purposes of life. The geometers have likewise demonstrated the causes of several celestial appearances which arise from the inflexion of its beams, both in the planets, &c. and in the phenomena which arise in the atmosphere of our earth. Of the fluids which surround, or float upon the surface of the globe which we inhabit, air and water, little could be known but for the assistance of geometry and mechanics. The elasticity and gravity of air have been discovered by mechanical experiments. From these properties, geometricians have calculated the height of the atmosphere, as far as it has any sensible density, and the result agrees with another observation on the duration of the twilight. Air and water are the objects of hydrostatics, though denominated only from the latter. The principles of this science were established by Archimedes, and by this science is illustrated those natural appearances which depend on the gravity and motion of fluids, the motion of solids in these fluids; and in considering the different pressures, celerities, and resistances of these solids, many practical observations have been pointed out, necessary for the business of naval architecture; and the solid, which shall pass through a fluid with the least possible resistance, has been ascertained. The calculation of mathematics on the motion of water through pipes, &c. are useful for several purposes. I might enumerate other arts and sciences which depend on mathematical principles. Thus perspective depends upon the rules of geometry and optics. The mathematics have reduced music to regular system, by inventing its scales; and there is hardly any part of mathematics which is not subservient to architecture. I might descend to the animal frame. The eye, the only organ of sense which the geometers have considered, is the only one whose structure and manner of operation is understood.

Every anatomist who would wish to understand the action of the bones and muscles, would need the knowledge of mechanics.

The usefulness of mathematics in several sciences and practical arts, is abundantly evident. They were reckoned by some of the ancient philosophers the key to all knowledge. Thus Plato had written above the door of his school, "Let no one ignorant of geometry enter here." It is not meant, however, that a knowledge of mathematics will enable any person to practise in any of the arts I have mentioned. Thus he who would attempt to compose music merely by his knowledge of harmonical numbers, could not be expected to produce very excellent pieces. To excel in several of those arts, besides the accuracy of rules, a person must be possessed of genius and fancy, and practice is necessary for them all. Yet still they owe their being to mathematics, which lays the foundation of their theory, and affords them precepts, which being once invented, are depended upon securely by practitioners. Thus, though many design who do not know the reasons of the rules by which they practise,—though many compose music better, perhaps, than the inventor of the scale could have done, and know nothing of the numbers on which their harmony is founded, yet as the mathematics show the foundation of these arts, they must be necessary for their improvement; and surely it will be granted, that he who knows the fundamental principles of what he professes, has the best chance of excelling.

RAILWAY EXPERIMENTS.

During the last ten years, railways have occupied much of the public attention. The Highland Society of Scotland has recently suggested for consideration, the points in which the system, as hitherto practised for local purposes and private objects, is defective or inapplicable, on a great scale, to the national object of establishing a general and improved system of land-carriage. On private railways, the load commonly goes one way only, and on a descending line; but for general carriage, and alternate trade, the load must go both up and down.—Speculation, practical and theoretical, has been keenly excited; yet truth and error still remain mingled in the public mind; and it is of great importance to separate them, by affording an opportunity of bringing to trial many new and highly interesting views lately brought forward on the subject. If a course of experiments prove these views to be unsound, it will be wise to pause: if, on the contrary, it is found possible to surmount the difficulties which present themselves to the establishment of general railways, it cannot be doubted that they will add incalculably to the resources of Great Britain.

To an associated body, the expense of such experiments would be an inconsiderable object. The rent of the ground occupied—a few hundred yards of railway—an inclined plane—a competent number of waggons—a locomotive engine, and a weighing machine—with the services of fit persons to conduct the experiments—would form the leading parts of the expense. Every individual experimenting separately must incur such expense; but were it once incurred in the case of an association, it would suffice for the public at large. An institution, therefore, affording facilities to ingenious men, without distinction of class or nation, to ascertain facts connected with the use of steam and animal power on railways, and to bring to trial, at a small expense, new inventions or improvements, would be highly desirable; and we are very glad to learn that it is proposed to establish a society for these purposes at Edinburgh. It is intended by the proposers of the society that the experiments shall be made under the eye of men the most celebrated for scientific and practical skill. It is in particular proposed, we understand, to request the assistance of the Professors of Natural Philosophy and Mathematics, the Members of the Royal Societies, of the Societies of Arts, and of the Schools of Arts in every part of the kingdom. The association will also, as a matter of course, be happy to avail themselves of the aid of engineers, and of all other individuals eminent for mechanical science—and particularly of engineers connected with or employed upon the railways now in progress or in contemplation. The experiments, so conducted, it is intended shall be duly recorded, and the details and results published and circulated among the subscribers, so as to serve either as a guide or as a warning to future inquirers.

This association is to be named "The Edinburgh Association for Railway Experiments."

To render the experiments an object of general interest, and that the association may comprise as great a variety of talent as possible, it is meant that no subscription should exceed three guineas, and that it may be any smaller sum. This limitation, however, is not intended to apply to public bodies, railway companies, and iron-masters, who will be allowed to contribute to any amount which they may deem suited to their interest in the objects sought to be attained.

We cannot help thinking that this association will prove of considerable importance, and deserves the attention of all those interested in improving the inland communication of the country. It is intended, too, that a public meeting shall be held in Edinburgh, for the purpose of originating the association; but in the meantime information with regard may be obtained, we believe, through Messrs. Gibson & Oliphant, W. S., or Claudius Shaw, Esq. Civil Engineer, Edinburgh.

MISCELLANIES.

Pouillet on Evaporation. — Pouillet, from a series of experiments he made, on the evaporation of liquids, infers, 1. That during the evaporation of perfectly pure water, no electricity is evolved. 2. That when water contains certain alkalies in solution, electricity is evolved, which is vitreous for the apparatus, when the alkali is fixed, and resinous when the alkali is volatile, as ammonia.

On the influence of the earth upon Meteors; by Professor Meinecke.—Professor Meinecke, in a memoir, read to the Natural History Society of Halle, endeavours to prove, in various ways, the existence of an inferior terrestrial atmosphere. He considers it as founded upon solid conclusions, that the atmosphere, which may penetrate to the depth of twenty geographical miles into the interior of the earth, is already compressed at a less depth, to such a degree, that, without being liquid, it forms a fluid equivalent to water. From this there results a mass of inferior terrestrial atmosphere in comparison of which the upper atmosphere appears very small, although equivalent, as is well known, to a column of water about 30 feet in height. It is to this mass of lower air, contained in the pores of minerals, in cavities and caverns, and even forming part of the elements of minerals, that Professor Meinecke attributes the greater number of meteors, while that insignificant body of air disseminated under the form of vapour, and which we have hitherto named the atmosphere, contributes at the most but a small part toward their production. As he attributes the barometrical phenomena to the inferior atmosphere, he in like manner denies the influence of the moon upon the weather.

Public Works in Lancashire.—The following is a list of the public works, for which the requisite plans have been deposited at the office of the clerk of the peace for the county, at Preston:—

Rail-Roads.—Liverpool and Manchester. Bolton and Manchester. From Bolton, to join the Liverpool and Manchester, at Eccles. Extension of the Bolton and Leigh Rail-Road, to join the Liverpool and Manchester, at Kenyon, near Winwick. Oldham and Manchester. Manchester and Audley, in Staffordshire.

Waterworks.—Preston and Fishwick.

Turnpike-Roads.—Diversion of Duxbury and West Houghton Road, at Blackrod. Diversion on Wigans and Ince Road. Diversion of the Road from Manchester to Salthouse Brook, by Mottram. New line of Road from Manchester to Bess's o'th'Barn, in Pilkington. The same with addition of a short branch. Renewal of the Pendleton District Trust with sundry diversions. Diversions in the Road from Lancaster to Richmond, in Yorkshire. Diversion of the Road from Bury to Whalley. New line of Road from Ridgehill, in Ashton-under-Line, to Saddleworth. Converting the Road from Hindley to Stirrup Brook, near Worsley, into Turnpike, and making a new Road under the same trust from Bedford, through Tildesley, to Over Hulton. New Branch of the Haslingdon and Whalley Road, commencing at Facit Brow, in Blackburn, and ending in Accrington.

Ambergris.—The origin of this substance is involved in complete obscurity. All that we know of it is, that it is most commonly found in lumps floating on the ocean, sometimes adhering to rocks, sometimes in the stomachs of fish—but whence does it come? by what process is it formed? Everybody knows the history of that greasy substance called Adipocire—that on digging up the bodies in the cemetery of St. Innocent's at Paris, many of them were found in part converted into a substance resembling spermaceti; and that it has since been ascertained, that if the flesh of animals, instead of undergoing putrefaction in air, undergoes the slower changes which take place under water, in a running stream, it is gradually converted into this substance. It is not an improbable conjecture, that ambergris is the flesh of dead fish which has undergone this change—that it is marine adipocire. And this conjecture is corroborated by a fact which was lately stated in one of the American newspapers. A marine animal of gigantic size has lately been discovered and dug up in the neighbourhood of New Orleans, in the groove of one of whose bones was found a matter closely resembling ambergris. This animal, which is supposed to be extinct, had been buried for an incalculable time.

USEFUL RECEIPTS.

A liquor to preserve bodies from fire is composed at Hamburgh of 1 part sulphur, 1 part red ochre, and 6 parts of a solution of copperas.

To Dutchify Quills.—Immerse the quill when plucked from the wing in water almost boiling; leave it there till it becomes sufficiently soft; compress it, turning it on its axis with the back or blade of a knife. The immersion and compression must be continued till the quill is clear when cold, and the membrane and greasy covering is entirely removed: it is immersed a last time to render it cylindrical, which is done by whirling it between the thumb and index finger; it is then dried in a gentle temperature. The French discovered this process when they conquered Holland.

Chinese method of rendering Cloth Waterproof.—To one oz. of white wax melted, add one quart of spirits of turpentine; when thoroughly mixed and cold, dip the cloth into the liquid, and hang it up to drain until it is thoroughly dry. This composition does not fill the pores of the finest lawn, nor change the most brilliant colours.

To take spots of grease from Leather Breeches.—Cover them with the white of an egg, and dry it in the sun. Another way:—To 2 table spoonfuls of spirits of turpentine, add half an oz. of mealy potatoes, to which add some of the best Durham mustard. This composition laid on the spots, and then dried, removes them; but if it does not do completely, (which seldom happens,) a little vinegar added to the composition will take them out effectually.

The blossoms of fruit trees are said to be preserved from frost by the following simple means:—Bring a straw rope through the branches of the tree, so as to terminate one end of it in a bucket of water; and should a slight frost take place, the tree will not be affected by it; but it will form a considerable film on the surface of the water. This is said to be taken from a paper in the Mem. of the R. Soc. Agriculture, Paris.

To freeze Water.—Take a small cylindrical tube of thin glass, about four or five lines in diameter, and two and a half, or three inches in length, open at one end and shut at the other. Put a slender spiral wire in this tube till it reach the bottom, then pour in water to fill the tube for seven or eight lines. The metallic wire is to draw out the ice when formed. A small glass syringe, with which children amuse themselves, is taken without its piston. Into this kind of a funnel, a quantity of well rectified vitriolic ether is poured, and the upper orifice is stopped with the thumb to prevent evaporation, and to make it trickle upon the tube with the water. The tube is held in the left hand, and turned about so as to be completely wetted with the ether flowing from the syringe in the right hand. The ether evaporates quickly, and carries off the caloric of the water, which soon becomes solid.

To purify Ether.—Take one pound of ether, put it in a bottle that will hold four of water; along with the ether put in two pounds of water. Cork the bottle, and shake it inverted to mix the liquors; then let it stand a little, and the ether will get to the top; pour off the water, and put in fresh water: do this till the ether is reduced from sixteen to five ounces. The water employed should be preserved, and the ether mixed with it extracted by distillation.

Composition for Ink.—3 oz. galls; 1 oz. logwood; 1 or 1½ oz. gum arabic; 32 or 40, but not above 48 ozs. water, but white wine or vinegar are preferable. When the vegetable matter corrupts, the ink becomes mouldy; to prevent which, add a few cloves ground to powder, with the gum and the water added gradually.

To secure Fruit.—Cut with scissors the petals of apple, pear, plumb, and cherry blossoms, close to the calyx; and almost all those cut will succeed though all the neighbouring flowers should miscarry. The fruit will not propagate its species.

To make Mortar that will turn as hard as a stone, even although exposed to moisture.—Take one part of unslaked lime, and three parts of sand, and let the whole be as much as one labourer can manage; then add the water gradually, and mix the whole well together, till it be reduced to the consistence of mortar, which is used immediately while hot, as mortar or plaster. The goodness of this mortar depends on mixing the ingredients well, and using it immediately after.

MECHANICS' INSTITUTIONS.

Mechanics' Institute at Tunbridge.—The Mechanics' Institute at Tunbridge continues to flourish. The President, Mr. Hargraves, gave a lecture on Gravitation and Attractions generally, which he concluded with a comprehensive description of the mechanical powers. From the clearness of style in which it was delivered, and the success of the experiments, which were numerous, and elucidatory of the different subjects, it was much calculated to forward the objects of the Institution, and was received by a numerous attendance of members with interest and pleasure. The society is now fully organized, and the interest is well kept up. A lecture is given every week, either by Messrs. Hargraves, Maddock, or Fry; amongst the members a considerable part are young men just entering on the active stage of life, to whom such an institution must be particularly useful.

Lewes Mechanics' Institute.—The members of the Mechanics' Institution at Lewes were lately gratified by a lecture on Mechanics, from their President, J. Woolgar, Esq. F. R. S. It displayed talent and perfectly extensive knowledge of the general principles of mechanism. The lecturer also gave his auditory a scientific insight into the alteration of the weights and measures. The Temple was well attended by the members, and several ladies and gentlemen attended to witness the proceedings of the evening. The interior of this building is neat, the new scene has a striking effect, and it is also rendered very comfortable by the erection of a stove in the pit, and such is the disposition of the proprietors to render it worthy the patronage of the public, that no pains or expense is spared in its completion.

Salisbury Mechanics' Library.—It has been determined to establish a lending library for the use of mechanics, servants, and others, resident in Salisbury and neighbourhood, and money has already been appropriated to that purpose. It is expected that the public in general, and particularly the master workmen, will, by their subscriptions, encourage so beneficial an undertaking, and thereby enable the managers to increase the library with books and treatises on the different arts and sciences.

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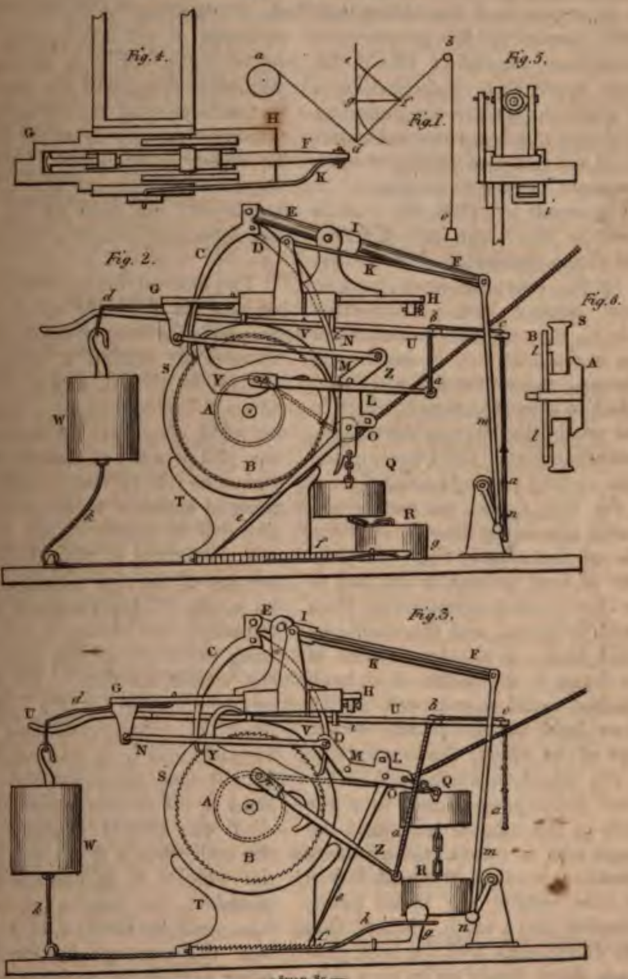
MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

> " Here let us breathe, and happily institute
> A course of learning, and ingenious studies.
> Then give me leave to read Philosophy."—*Shakespeare.*

No. CXVIII. *Saturday, 25th March,* 1826. Price 3*d.*

SELF-ADJUSTING CRANE.

Invented by Mr. James Jones.



—Swan Sc—

Vol. V.

SELF-ADJUSTING CRANE.

Invented by Mr. James Jones.

The defect usually attributable to cranes is, that it is necessary to pass through as much space to raise a light load as a heavy one, unless an alteration be made in the relative velocities of the power and the load, by manually changing some wheel or pinion. To obviate this objection, and conceiving that cranes possessing the property of spontaneous regulation would be a near approach to perfection, was the leading motives in inducing Mr. Jones to attempt the construction of the crane of which we are now about to give an account.

The means by which the load is raised in his crane are different from those usually employed, that is, by the universal lever; and as many persons are unacquainted with it, it may not be improper here to describe it. It consists of a large vertical ratchet-wheel attached to a barrel, round which a rope winds, drawing up the weight. Immediately over the wheel, in the same vertical plane, is fixed a lever of the first order, the end of the shorter arm being directly over the axis of the wheel; there are two rods of iron jointed to the end of the lever; one terminating in a broad flat point, and the other in a broad hook; if the longer arm of the lever is depressed, the hook attached to the shorter end having taken hold on the tooth on one edge of the wheel, draws that side of the wheel upwards, whilst the broad point passes freely over the teeth on the other side: but if the longer arm is raised, the contrary operation ensues; the hook looses its hold, whilst the broad point, dropping into a tooth, thrusts that side downwards, and the hook proceeds down freely on its own side, preparatory to taking a fresh hold. Thus, by continually working the lever up and down, its reciprocating motion is converted into a rotatory one in the wheel and barrel, thereby raising the weight attached to the rope.

In this application of the universal lever to the raising of weights, there is nothing very new, but the principle of self-adjustment, comprised in the variation of the proportionate lengths of the two arms of the lever, and that variation effected by the agency of the load to be raised, independent of the personal interference of the labourer employed; and such as Mr. Jones has introduced seems to be entirely new.

The basis of his method of self-adjustment is simply this:—that if one end of a line is fixed, and the other end, having a weight attached, is passed over a pulley at some tolerable distance, that part between the point of fixture and the pulley will, of course, form a right line; but if another weight is hung in between those points, the line will be drawn down more or less, according to the relative proportion of the two weights. Thus, let *a*, (fig. 1,) represent the point of fixture; *b*, the pulley; *c*, the weight hung to the end of the line, and *d*, the weight attached to the middle, or any other part of the line; then draw *d*, *e*, perpendicular to the horizon, and *e*, *f*, parallel to *a*, *d*, so will *e*, *d*, represent the weight fixed to the middle of the line, and *d*, *f*, the weight suspended from the end; thus it is evident, that as the weight, *c*, is increased or diminished, the weight, *d*, rises or falls, until the lines, *e*, *d*, and *d*, *f*, bear the same proportion to each other as their respective weights.

Such is the principle: the man-

its application is now to be
ed.

Description.

. 2 and 3 are sections with-
e frame-work, showing the
ns of the parts at different
s of their operation.

4, a bird's-eye view of the
perforated fulcrum, and great

5, an end view of the slider
rforated fulcrum, and of the
e, on which the brake-lever
its bearing, when, by means
relieving rope, it is raised
break-wheel.

6, a section of the end of
ain-barrel, break-wheel, and
d wheel, and showing, by the
rojections, *l*, *l*, the situation
teeth on the outer face of
eak-wheel, and in which the
on the inner face of the
d wheel take hold in lower-

is the chain-barrel; B, the
on which the claws of the
perate; C, D, the two claws
to the end of the great
E, F; G, H, is the slider
ing the fulcrum of the lever;
perforated fulcrum or socket,
in shape to the middle part
nnon cut off in each side of
nnions, on which, as on two
the lever performs its alter-
s, whilst the fulcrum occa-
y slides along it. K, is a
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end, and moving on a centre
a standard fixed to the frame-
of the crane at the other, so
prevent any longitudinal mo-
the great lever; L, is the regulator, being a frame hanging from the centre, M, on which it turns upwards; N, is a rod connecting the top arm of the regulator with the slider, G, H; O, is a roller, (contained in the frame of the regulator,) under which the crane rope or chain passes from the gibb, after having gone over the pulley, to the chain-barrel, A; Q, is a weight suspended from the regulator; R, is another weight suspended at such distance below Q as to rest on the floor, and, consequently, does not come into action until the regulator and the other weight have attained a considerable elevation. These weights retain the regulating frame in a vertical position, and the sliding fulcrum at its greatest distance from the wheel-end of the lever, and, consequently, when the lever is worked, will produce motion in the wheel, amounting to a considerable portion of a revolution at each alternation; but if the load is hung to the end of the rope, the endeavour of that load to form the rope into a right line, gives the regulator a tendency to rise; if the load is increased, the regulator rises still higher, and, by means of its top, arm, and connecting rod, slides the perforated fulcrum closer up to the head of the lever, which causes the wheel to move through a smaller arch of the circle, corresponding with the altered proportion of the lengths of the two arms of the lever, thus augmenting the effect of the power applied to the other end, in nearly the same ratio as the addition to the load.

(*To be continued.*)

HE STATE OF LEARNING AT THE BEGINNING OF THE VENTEENTH CENTURY; AND THE ORIGIN OF THE YAL SOCIETY OF LONDON.

EF in the influence of the stars
fortune and character of man, together with the attention always unavoidably given to the measure-

ment of time, preserved some knowledge of astronomy among our ancestors, even in the darkest ages of modern Europe; and rendered it one of the first objects of zealous study at the era of the general revival of learning and science. The alchemical dream of the convertibility of all baser metals into gold, engaged many an enthusiast and many an impostor in experiments in chemistry, from the earliest period in modern history from which we have any information of the pursuits of the inquisitive and the learned. The uses of common life, and the restoration of this part of the science of the ancients, encouraged and advanced the study of mechanics even in the fifteenth and sixteenth centuries. No other branch of physical science but these three had been much or successfully studied by the moderns before the days of Bacon.

It was the grand merit of Bacon, that he turned mankind from investigating in science "merely the relations of existence (in general very imperfectly known) and of words,—to acquaint themselves more fully, by the experiment of the senses and of auxiliary instruments, with existence in its different sensible modifications, and with the mutual relations of the various parts of material existence to one another." Science was thus at once reduced to "experience, and the arrangement of the facts which experience ascertained." The united inquiries, observations, and memoranda of as many as possible of the intelligent and enlightened part of the human race, were henceforth understood to afford the only means for its true improvement. Men became now first sensible, that, by due investigation of the qualities and the phenomena of matter, they might discover modes of science unknown to the ancients. And the

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began to be formed at Caen. At Aix, in Provence, the illustrious Pierese, the Robert Boyle of France, not only corresponded with the most eminent and ingenious men in Europe, on almost every interesting subject in physics and in the study of antiquities, but engaged his friends often to assemble in his house for the mutual communication of their observations and discoveries, as well in natural philosophy as in every other part of knowledge. But the institution of an academy of sciences was reserved to distinguish, at a period somewhat later, the ministry of Colbert, and the most splendid part of the reign of Lewis the Fourteenth. The professors in the German universities occasionally met and conversed about the subjects and ends of their studies; but in these, physical science had, hitherto, but small share; and there was not as yet, in Germany, any separate company of philosophers associated for the investigation of the laws of material nature.

Dr. Seth Ward, the Hon. Robert Boyle, Dr. Wilkins, Sir William Petty, Mr. Mathew Wren, Dr. Wallis, Dr. Goddard, Dr. Willis, Dr. Bathurst, Dr. Christopher Wren, and Mr. Rooke, were the principal persons who associated at the meetings in Wadham College. They met rather to perform experiments, than to discourse about them. Mechanics and chemistry were the branches of science to which their first experiments chiefly related. In the year 1658, the scene of their meetings was transferred from Oxford to Gresham College, in London. Their numbers were here soon considerably augmented. Their meetings were, for a time, interrupted by the disturbances which ensued between the usurpation of the Cromwells and the restoration in 1660.

At the restoration, two Scotsmen, Sir Robert Moray, of Tibbermuir, and a Mr. Erskine, who, having followed the king in his exile, had now influence at court, eagerly joined the philosophical meetings at Gresham College, and persuaded their sovereign to take the rising society under his own special patronage. A royal charter was soon after granted, incorporating these philosophers into a body, to consist of a president, a council of one-and-twenty members, and an indeterminate number of fellows. William Lord Viscount Brounker became their first president. The institution was, for a time, very much an object of fashionable attention at court. The king himself, as the patron and founder, the duke of Buckingham, prince Rupert, the earl of Clarendon, the first earl of Shaftesbury, Monk duke of Albemarle, duke Albert of Brunswick-Lunenburgh, the earl of Peterburgh, were enrolled at the head of a number of distinguished names in the first list of the members—*Omne ignotum pro mirabili.* For a time, the most extravagant enthusiasm was excited in favour of the new society, and from its exertions and improvement the most extraordinary of all the arts of life was expected at once to ensue.

The meetings of the society continued after its incorporation by charter, as before, to be held at Gresham College. They took place every Wednesday in term time, immediately after the lecture of the professor of Astronomy in that college, and were eagerly attended by the members. Dr. Croone, with the title of register, had, at first, the care of recording the transactions at these meetings in journals. It was afterwards committed to Dr. Wilkins and Mr. Oldenburgh, the two first secretaries. Cowley had demanded a revenue of £4000 a year for his projected college at Chelsea; but the Royal Society was supported without any public fund, simply by the voluntary contributions of the gentlemen of whom it was composed.

The society entered upon its researches with views at once magnificent and philosophically modest. It proposed but "to make faithful records of all the works of nature and art." By these it hoped to explode errors, to restore neglected truths, to apply philosophy to the uses of life, and to open up the avenues to future discovery. It professed to admit into its association men of all religions, all countries, all conditions and employments in life. They proposed to derive useful truth not only from the learned and professed philosophers, but from the shops of mechanics, the voyages of merchants, the ploughs of husbandmen, the sports, fishponds, parks, and gardens, of gentlemen. Some hesitated whether Mr. Grant, a small shopkeeper in London, the author of some excellent observations on the bills of mortality, should be received into such a company of philosophers. But king Charles, on perusing his observations, not only recommended his immediate admission, but desired that they would add to their number as many shopkeepers as possible of equal endowments.

In their researches they would not trust the reports of others in any case where they could bring the matter under the examination of their own senses. In some instances they allowed particular members to choose whatever subjects they should think proper; to institute, at pleasure, any train of experiments on them; to defray the expense from the purse of the society; and then to report at the meetings the series and the results of the experiments they had thus made. Other experiments were expressly ordered by the voice of the whole society, and were intrusted in the performance, not to single persons, but to committees nominated for the occasion. For inquiry concerning things at a distance, they had, very early, begun a correspondence with the inquisitive and enlightened in almost every different part of the world. At many experiments in the parks, in the royal gardens, and on the Thames, the king himself zealously assisted in person. Mr. Huggens, the famous philosopher in Flanders, received, soon after the institution of this society, its frequent assistance, and communicated to it all his discoveries and inventions; in particular, that noble one of the first application of the motion of pendulums to clocks and watches. The philosophers of Florence, and especially the grand duke's brother, prince Leopold, entered into friendly correspondence with the English philosophers, and acquainted them with every new observation that was made on nature in Italy. The Germans no sooner heard of this institution than they sent many of their books to be submitted to its censure, and contributed likewise presents of various new instruments of their invention. The travellers, physicians, surgeons, anatomists, &c. of France were peculiarly early and frank in their communications to it. The Academy of Arts and Sciences at Paris was soon after embodied in imitation of this society: and the example of the English was quickly, more or less, followed in almost every country of Europe in favour of the physical sciences and the useful arts.

The experiments to which king Charles was the most attentive, related chiefly to chemistry and mechanics. He would often amuse himself at Whitehall in the execution of curious mechanical works. He had also in his palace a small laboratory for chemical operations. He made astronomical observations, upon various occasions, in Saint James' Park. He was exceedingly curious in directing the inquiries of the society to every thing that concerned the improvement of the art of ship-building. He attended and directed different experiments at the tower of London, as well as at Whitehall, to ascertain the forces of projectiles, with their variations in different circumstances.

In their early meetings, the members of the society were at great pains to distinguish what objects were the worthiest of their first inquiries. Some were directed to examine all "treatises and descriptions" of the natural and artificial productions of foreign countries: others were commissioned to discourse with seamen, travellers, tradesmen, and merchants, by whom those countries and their productions had been personally examined. From the union of the *viva voce* with the written intelligence, papers were formed, explaining summarily what was known concerning every different country, and what remained to be yet inquired into. These papers were read at subsequent meetings, and queries were then drawn from them, to be transmitted for answers to the society's foreign correspondents.

One set of queries which were prepared among the earlier labours of this society, had for its object, to mark, "what things were needful to be observed in order to the making of a natural history in general." They formed similar queries respecting the histories of the air, atmosphere, and weather; of the production, growth, &c. of vegetables; of agriculture, &c. They marked out trains of experiments to be tried on rarefaction and condensation; on the petrifaction of wood; on the loadstone; on the discoveries wanted to complete the science of anatomy; on injections into the blood of animals, and on the transfusion of the blood of one animal into another; on the tides of the sea; on the varieties of oysters, and the manner of their nourishment; and on the phenomena of mines. They gave directions to seamen for the observation of the eclipses of the moon, the eclipses of the sun by Mercury, and the satellites of Jupiter. They sent abroad directions for observations and experiments to be made in India, China, the islands of St. Helena, Teneriffe, Guinea, Barbary, Morocco, Spain, Portugal, Turkey, France, Italy, Germany, Hungary, Transylvania, Poland, Sweden, Iceland, and Greenland.

One of the first answers they received to their inquiries concerning foreign countries, was sent from Batavia, by Sir Philiberto Vernati. It corrected an error, prevalent in Europe, "that diamonds and other precious stones were in the Indian isles continually renewed, as by vegetation, in the quarries out of which they were taken." It informed them of the existence of a volcanic mountain in Java, and another in Sumatra. It exploded a vulgar error, which one should have thought to be, even otherwise, incapable of obtaining for a moment the assent of philosophers, "that there was in the island of Sambrero, lying north from Sumatra, a sensitive plant that would, when pulled with the hand, shrink into the earth, and that had for its root a living worm." It added a variety of other curious information concerning the most extraordinary objects and arts in the East. But of the queries sent out, it left still many unanswered.

Mr. Hooke was one of the most

ingenious and indefatigable of the early members of this society. He explained, in an admirable paper, the best method of making a history of the phenomena of the weather. He made many experiments, which were repeated, with many variations of circumstances, by the society, to prove, "that visible and sensible fire was but the act of the dissolution of heated bodies by the air: that this dissolution of such bodies took place in a manner perfectly similar to the solution of iron, tin, and copper, by acids: that the evolution of heat and light was a necessary result of the solution of heated and combustible bodies in air." This chemical theory differs from that which was proposed by M. Lavoiser, and is now deservedly received as philosophical truth, only in being expressed in the chemical dialect of that time, which is now obsolete; and in being, in the intention of its author, to a certain degree accommodated to other theories which then prevailed.

They instituted a multitude of experiments to determine the nature, properties, and uses of air. By the care, especially of Mr. Boyle, many trials were made to find, by means of the baroscope, the different degrees of the pressure or gravity of the atmosphere at different heights and depths. They took much pains to discover the opposite limits of the rarefaction and the condensation of air. They made a variety of experiments on the propagation of sound in air; and what is, in a chemical point of view, highly remarkable, a number of their experiments were directed to ascertain "the generation of air, by corrosive menstrua out of fermenting liquors; and to determine the fitness or unfitness of such air to support combustion and respiration." Other experiments were made by them for the purpose of discovering how long a man might live by inspiring and respiring the same air; whether air contaminated by respiration might be again made pure and respirable; and whether the unfitness of contaminated air for respiration were not a quality altogether independent of its temperature, as hot or cold.

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IMPROVEMENTS IN GEORGE'S SQUARE.

GENTLEMEN,—It has been proposed to add to the improvements going on in George's Square a water jet, or fountain, but as the expense of the water would be a considerable sum annually, and the water could be put to no use, allow me to point out a way by which the object in view could be accomplished with no other expense than the first outlay.

As many steam engines are supplied with water by the water companies, take the pipe which is to supply the fountain from the pipes of the water company that supplies the steam engine nearest to the square, and let the waste water of the fountain be conveyed into the well of the steam engine by a proper pipe. By putting a float to regulate the flow of water, just as the engine takes it from the pond or well which receives it from the fountain, the engine would be supplied as formerly, and the water company sustain no loss, while the square would be furnished with an ornament at a small expense to the proprietors.

Perhaps it would be proper to make two fountains, one near each end; or to have in the centre of the square a pedestal surmounted by a vase, from which the jets are to be played, the falling water to be received by an elliptical pond, in the centre of which the pedestal stands, and round it eight large trees might be planted, two and two together, allowing their branches to touch, so that the fountain might be seen as through arch ways. This would give a grandeur to it that is not possessed by any square that I have heard of.

I know it is said by many, that large trees when transplanted do not thrive. To refute this, I need only refer to the estates of Allantown or Jordanhill; there are to be seen trees in groups, formerly scattered over the lawn, (as if they were now enjoying the repeal of the combination laws,) others that were in groups, scattered, (as if they had broke up the conference.) By these alterations, under the direction of the enlightened proprietors, some of the finest views have been opened up which are to be seen on these estates, while the trees are flourishing and in perfect health, as if they had never been moved. I have no doubt that if applied to, the requisite machinery and every information would be furnished by any of the enterprising proprietors of the estates above alluded to.

If you think the above worth notice, your giving it a place in your Magazine will oblige

A FRIEND TO IMPROVEMENT.

ANDERSON'S INSTITUTION.

THE members of this Institution, deeply sensible of the very great benefit which they have received by the attention and assiduity of Mr. Condie, their curator, as well as of the pleasure and instruction they have derived from his ingenuity as mechanist, agreed to present to him, previous to his leaving them, some token of their grateful remembrance; and on Friday evening, the 10th instant, after the lecture, he was presented with a valuable and elegant gold watch, having the following inscription engraved upon it by Mr. Gray, Junior:—

Presented to
MR. JOHN CONDIE,
By the Members of Anderson's Institution,
As a mark of their Respect.
Glasgow.
1826.

Dr. Ure having been requested to present the watch to Mr. Condie, addressed the meeting in the following words:—

"Gratitude is an emotion no less delightful than it is honourable to the human heart. Directed to the Father of Lights, from whom descends every good and perfect gift, it constitutes the essence of devotion; to parents and guardians it is the foundation of filial piety; and to benefactors in general, it is the source of genuine friendship. As the immortal mind is infinitely superior to its frail and perishable tenement, so ought he who ministers to our intellectual enjoyments to be rewarded above him who contributes to merely corporeal pleasure. Yet by a perversion of right feeling and judgment, it too frequently happens that mankind heap their favours on the minions of sense, or those who pamper their more grovelling and gross propensities, while they neglect the genius who exalts the species by the discovery of truth, or by extending the empire of mind over the stubborn elements. You, my pupils, have made a better choice, and have arrived at a wiser decision. This substantial tribute of your esteem, which you have commissioned me to bestow, shows that you relish mental improvement, and gladly embrace an opportunity of expressing your gratitude to the person whose labours have tended to promote it. In this testimony of your regard I entirely concur. My situation has often brought me into contact with Mr. Condie, and I think him well worthy of your benefaction. In the midst of many difficulties, he has executed a variety of ingenious mechanisms, which will prove permanently useful to yourselves, to this establishment, and to the city of Glasgow. I shall not consume your time just now with the detail of his labours; but shall be happy to draw your attention to their results in the progress of the lectures. I can safely assert, that when left to his own judgment he was little liable to err.—Mr. Condie, in delivering to you this handsome token of the regard of my students, may I express the satisfaction which I personally experience in being called to exercise so gracious a function; and if the same docility, industry, and talent, which have attended your efforts as mechanist of Anderson's Institution, continue to shed their genial influence, there is no doubt that your future life will correspond in respectability and usefulness with this its auspicious beginning."

To which address Mr. Condie made the following reply:—

"Ladies and Gentlemen,—The very great obligations under which you have laid me by this truly valuable present, have almost deprived me of the power of returning you my most sincere and heartfelt thanks—indeed I shall never be able adequately to do so in words; I must, therefore, trust to showing it by my actions; and since my humble efforts have been considered worthy of your notice, they shall now be more ardent than ever, for to this Institution, and to your worthy Professor, Dr. Ure, I owe every thing that I know. The advantages which the mechanics of Glasgow have enjoyed in this Institution have been very great, and these advantages have been not less owing to your talented Professor than to the public spirit of the founder of the Institution, and those who have it under their superintendence. The praise-worthy conduct of the thousands who have attended the lectures within these walls is well known and appreciated. Twenty years ago, the desire for instruction in this city was as great as it is now;—twenty years ago, the lectures here were as well attended as they are now;—twenty years ago, your worthy Professor was as able to communicate knowledge as he is now;—but mark what change twenty years has produced: at that period there was not such another Institution in the whole world; but at the present day there is scarcely a town, or even a village, in Great Britain without its Mechanics' Institution, so great is the spread of knowledge.

"The advantages which this the Parent Institution has conferred on the community are incalculable, and we, therefore, should be proud that we are its members. It shall ever be the proudest boast of my life that I was once a working mechanic who assisted in the fabrication of its apparatus, and that while lifting the hammer in behalf of Science, she condescended to throw her inspiring mantle over one of her humblest sons of labour; that I toiled under her benign influence, drank from her pure streams of knowledge, and spent my hours in her service. On these seats have I sat and heard the valuable truths of philosophy from the lips of your worthy Professor, Dr. Ure; and here have I assisted him in many interesting experiments, which he explains with a facility altogether unrivalled.

"The uniform kindness which I have experienced from the managers demands my warmest expressions of thanks and of gratitude; but to Dr. Ure I owe more than I can express. It was he who first gave me a taste for knowledge—it was he who first showed me the value of it—and it was he who first instructed me in those operations which you have deemed worthy of your approbation; and when I look upon this splendid present, I shall think how much it is due to my father in philosophy.

"A more appropriate present could not have been given to one whose early and chief delight was the study of the various mechanisms for the measurement of time; and I trust it shall not only remind me of the value of time, but of the kindness which instructed me to lay it out to the best advantage, and of the unbounded generosity of those who bestowed such a valuable piece of mechanism upon one whose only desire was to do his duty.

"It would be ingratitude in me to allow your public spirited committee to pass unnoticed; to their unwearied exertions this Institution owes the greatest obligations, and I trust they shall meet with the thanks of the members, which is their just reward. May they never weary in the glorious work in which they are engaged; and when they retire with their merited honours, may there be found kindred spirits imbued with the same love of science, and disinterested wishes for the diffusion of knowledge, to fill their highly important situations in this Institution."

METEOROLOGICAL OBSERVATIONS.

GENTLEMEN,—Having seen some observations on the weather in different places, I resolved to try how these tables would tally with the state of the weather in this country: for this purpose, I regularly marked it down each day during the last year, beginning with the 1st of January 1825. The result is as follows:—There were 180 fair days, 18 of which were frosty; 185 rainy days, 23 of which were constantly raining, and as for snow we had little or nothing of it. This differs widely from some observations contained in the Journal de Physique, one of which is, that "the number of rainy days from 51° to 60° is 161;" so that it appears that it rains much more in this place than in others of the same latitude, besides that we reckoned the last season the dryest that we had for some time past.

I also observed the direction of the wind during the above-mentioned period. I find it differs much from the prevailing winds at London, published in the transactions of the Royal Society, and as much from that published in the fifth volume of the Statistical Account of Scotland, as observed by Dr. Meek near Glasgow.

		East.	West.	North.	South.	S. E.	S. W.	N. W.	N. E.
At London.—	No. of Days.	26	53	16	18	32	112	50	58
At Glasgow.	Do.	...	...	...	...	47	174	40	104
At Easdale.	Do.	16	36	25	69	40	81	71	27

I should have observed that it was the prevailing wind of each day I mentioned.

If you deem this worth a place in your useful Magazine, the insertion of it will greatly oblige,

Yours, &c.

Easdale, 9th March, 1826. J. WHYTE.

TO RENDER PENCIL DRAWINGS PERMANENT.

GENTLEMEN,—If the following be found worth insertion in your Magazine, it may prove of use to some of your numerous readers.

How to render Pencil Drawings permanent.

Pencil drawings are very easily soiled and destroyed. To render them permanent it is the practice to touch them with Indian ink; but I have always found that however carefully the ink is applied, the effect of the drawing is greatly injured. In order to prevent this I have tried many plans, and I find that by applying carefully to every line of the penciling a very weak solution of gum arabic, the finest drawing may be rendered perfectly permanent, without the effect being in the slightest degree injured.

I am, yours, &c.

ELIZA.

Hutcheson-Street, 2d March, 1826.

ESSAYS ON BLEACHING,

By JAMES RENNIE, A. M. Lecturer on Philosophy, &c. &c., London.

No. IV.—CHEMICAL AND PHYSICAL NATURE OF STUFFS.

2. *Wool.*—For our knowledge of the texture and composition of this important material of the cloth manufacture, we are greatly indebted to Detubenton. The qualities of wool as to length and tenuity of fibre, vary according to the parts of the animal whence it may have been taken; to the breed of sheep from which it is produced; the climate where they live; the pasture where they feed; and according as the animals are healthy or diseased. That which grows on the neck, the sides, and the back, is the finest part of the fleece, and fortunately the most abundant. The best breeds are found to degenerate in certain climates and certain pastures, of which we have an illustrative instance in the European breed in some places of America, which now produce hair instead of wool. This seems to depend on the same general principle with the effects produced on wool by the diseases of the animals, the most healthy affording always the best—for change of climate and food may alter the constitutional secretions as much as disease. Great attention has lately been paid in Britain to those circumstances which affect the qualities of wool, and great improvements have been made by the sheep farmers. This is of much importance, as we are indebted to Spain for all our finest wools. As the fineness of wool cannot be accurately ascertained by simple inspection, the manufacturer ought to compare the different specimens which may be offered to his purchase by means of a microscope. When the wool is in its natural state, it is protected from moisture by a substance of a soapy nature, called *yolk* by

the English, and *eek* in Scotland. This, according to M. Vauquelin, (Ann. de Chim. xlvii. 276,) consists of a basis of potash combined with an animal oil, together with lime united to the carbonic, acetic, and muriatic acids. This nutritious matter is always most abundant on the wool of healthy sheep.

Mr. Mushet found, that after distilling in the dry way 180 grains of pure white wool, there remained a residuum coal, of a dark shining gray colour, welded or caked into one mass, adhering in part to the sides of the retort. It weighed only 43 grains, having lost in distillation 137 grains. In a 100 parts, therefore, are contained 76 volatile matter, and 23.89 oxide of carbon.

The mechanical structure of wool is worthy of attention, both as an object of curiosity, and as, probably, of some importance in explaining the rationale of bleaching it. This structure was first described by the Abbe Monge, (Ann. de Chim. vi. 300;—see also Nich. quarto Journ. i.) he having discovered it when examining the process of fulling. According to this philosopher, the fibres of wool consist either of *laminæ* lying in a slanting manner upon one another, from the root to the extremity, somewhat like the scales of a fish; or of a series of rings gradually decreasing in diameter from the root to the point, and overlapping one another as in the horns of animals. M. Monge states, and his statement is repeated by Bancroft, and in the Edinburgh Encyclopedia, that this structure may be perceived by drawing a fibre between the thumb and finger, from the point towards the root, in which case a tremulous motion, it is said, will be distinctly felt, accompanied with a sensible grating noise. Now I am disposed to controvert this; for upon repeated trials, with fibres of every degree of fineness, I could neither feel the motion nor hear the grating. This cannot even be perceived in the coarse hairs of cows and horses, though those have a similar structure. The only way by which it can be made sensible, is with a microscope, or by putting a hair between the finger and thumb, and moving them gently upon one another, when the fibre will move forward or backward, according as the point or the root is placed anterior or posterior to the part by which it is held. This property of hairs has been long known to some of our peasants, who take advantage of it to excite the wonder of the ignorant, by telling the root or the point of any hair, although it be cut into ever so many pieces. It is on this structure that fulling and felting depend; it is to smooth the asperities caused by it that spinners grease their wool; and it is in the interstices of the laminæ that the colouring matter, which it is our object to find a method of removing, is lodged. The laminæ seem to be elastic, and, consequently, the pores must be dilatable by heat. This it may be useful to remember.

A NEW ROTATORY STEAM ENGINE.

CONTEMPLATING the disadvantages under which that powerful agent, steam, laboured in its application to the atmospheric engine, a method occurred to me in which its immense power would be exerted on a wheel, without requiring any thing like the massy beams, cranks, &c. in the common one, and which comparatively would occupy little or no room. I made a small model of it, part of lead and part of timber, which I found to exceed my expectations; but that part made of timber swelled shortly after the steam was on, thus stopping its motion, otherwise it wrought remarkably well. Nothing can be more simple than this engine. It consists only of one wheel, made and incased in a certain manner, so that the steam cannot escape without turning it, and it will have a lever equal to half the diameter of the wheel to work upon, and square surface of any given size. It is equally well adapted to a water-wheel—in my view it would make an unparalleled one for power, where there was a good fall; for a column of water, equal to the fall in height and in width, in proportion to the supply, would have its whole weight on it, as on the end of a lever equal in length to half the diameter of the wheel; and in places where there was not a constant supply of water, without any alteration in its position or arrangement, by having a boiler near it, the steam might be set on when water was not to be had. I tried water to my model, admitted by the same pipe which conducted the steam, and it turned it well.

As it is beyond my power to procure a patent, yet wishing to make something of my invention by communicating it to another, any engineer who wants to know more of it, will be attended to by addressing a letter (post paid) to John Whyte, Joiner, Easdale, by Oban.

Easdale, 28th Feb. 1826.

LETTERS AND QUERIES.

[WE have no wish to enter into any discussion of the questions alluded to in the following communication; and we are of opinion that the perusal of Mr. Place's article sufficiently answers all that our present Correspondent has said. Yet, as our chief object has ever been a candid investigation of truth, we have given insertion to this communication. We beg to state to our Correspondent, however, that such a message as he asks us in his Postscript to deliver to Mr. Place, we feel no inclination to be made the bearer of.]

GENTLEMEN,—I am yet to learn what, or if any real benefit has resulted to the laborious man from the acts of parliament, commonly called Hume's act, with the amendment of the same. I have seen, to be sure, the colliers dictate to their employers; and coals, which could have been bought at 10s. selling for 16s.; and dross, such as was sold for 3s., selling for 7s.;—and yet neither the colliers nor their masters bettered, while not a few thousand pounds have been drawn from the pockets of the Glasgow householders and manufacturers.

I should not have at all chosen your work for the vehicle of any thing I had got to say on such a subject, did it not appear to me that instead of teaching mechanics, (the object, I think, of your publication,) you are giving *place* to opinions that will ruin the working classes,—I refer to Mr. Place's Essay, in your Magazine, and particularly to page 30, where, if there is not contradiction, there is somewhat more dangerous. I should be glad if Mr. Place would have the goodness to explain how operatives are to cease to produce workmen faster than employment can be found for them?

Are they to cease from begetting children, as Malthus would advise, and so decrease the population? Are they to take the power of the workshop, prevent the employment of apprentices, and thus let their own sons and those of others grow up idle? Or are they to force all the youths of our country to emigrate, and leave the field of labour free to themselves?

These seem to me questions that Mr. Place cannot answer; how, then, do you allow such opinions to be sported through a work which is *intended* for general circulation among operatives?

I should be glad to hear from Mr. Place how he is to "*restrict*" the operatives in the present state of trade, when one-half of the working population are not employed; where will he *place* the other?

ANTI-PLACE.

15th March, 1826.

GENTLEMEN,—To your admirer and lover of white broth, who writes you at page 191, of Vol. IV., allow me to say, that an intelligent person in the cast iron trade recommends purchasers of new pots to fill them with water and put a quantity of grease of any kind into them; set them on the fire until all the water evaporates, and only the grease remains: the pot will then be equal to any old one.

B.

GENTLEMEN,—As I perceive that many of your readers have recourse to you for a solution of a number of questions which to them appears difficult, and that either you or some of your Correspondents are kind enough to solve many of their difficulties, I, as one of your readers, and being encouraged by these examples, feel inclined to adopt a similar plan, being unable to get over a *pons asinorum* which stands in my way, or a difficulty which I find as insurmountable as our Sabbath day walkers find H——'s dyke on the banks of the Clyde.

The particulars connected with the question which I have to put to you, Gentlemen, are the following, which I shall state as briefly as possible:—

Having been lately engaged in making a few chemical experiments, which I conceive to be both a rational and instructive amusement, I turned my attention to calico-printing, and amongst other experiments which I made in this important chemical art, I was anxious to obtain a permanent green on a turkey-red ground. For this purpose I adopted the following plan:—Having dissolved a small portion of granulated or dropped tin in a little muriatic acid, I put into this solution some well pounded prussian blue, mixed these intimately, then added a little gum, and thickened the whole with pipe clay. In another vessel I put a little tartaric acid and water, which, as soon as the acid was dissolved, I poured into the vessel which contained the other ingredients, and mixed the whole. Having brought this compound to the proper consistency for printing, it was applied to the cloth by means of a block. The cloth being dried, by holding it to the fire, it was immediately plunged into a solution of oxymuriate of lime, when the parts to which the block had been applied were instantly changed from the whitish appearance which the pipe-clay had given them, into a fine light-blue. The cloth was then taken out of the oxymuriate of lime and washed in cold water, and immediately immersed in a solution of bi-chromate of potash, on doing which, the light-blue was suddenly converted into a beautiful green, at the sight of which I was highly gratified, verifying the language of the poet when he says,

> "The starving Chemist in his golden views
> Supremely blest!—the Poet in his muse!"

But alas! my bliss in this instance was not of long duration, for as soon as I had taken the cloth out of the chrome and put it into cold water, my fine green vanished, "like the baseless fabric of a vision," and the light-blue was again restored. Now, according to my information, this green ought to have been permanent. What, then, is the cause of its not being so? I hope, Gentlemen, that either you or some of your Correspondents will favour me with an answer to this question, by doing which you will greatly encourage and very much oblige,

Yours, &c.

PHILOLOGUS.

Paisley, 11th February, 1826.

GENTLEMEN,—Will any of your Edinburgh Correspondents gratify their western neighbours by giving a plate and description of the Regalia of Scotland?

J. W.

GENTLEMEN,—If any of your Correspondents could inform me through the medium of your useful Magazine, what is the best, or most effectual and cheapest method of destroying these abominable vermin, "*bugs*," they would oblige thousands, besides

ι. ω. ν. γ. π. λ. ∂.

West St. Vincent-Street,
Glasgow, March, 1826.

Gentlemen,—Will you or any of your numerous Correspondents, through the medium of your Magazine, inform a constant reader what is the best method of procuring gas from peat? What is the best apparatus for that purpose for a private house? And what time will it take to consume a cubic foot of it by a single burner of the common size?

Gentlemen,—Perhaps some of your Correspondents would be so kind as favour me with an answer to the following: If the atmospheric air which we breathe is found to be oxygen and nitrogen, and the air which comes out of the lungs is found to be carbonic acid gas, pray, what becomes of the nitrogen?

By inserting this you will oblige,

Yours, &c.

Alex. D—r—y.

Gentlemen,—I should feel much obliged if any of your kind readers could inform me, through the medium of your Magazine, by what means I could most economically purify the *ammoniacal liquor* of the gas works, to form pure water of, or liquid ammonia, or carbonate of ammonia. The ammoniacal liquor being a compound of a carbonate and sulphate of ammonia, as well as a sulphuret of ammonia. By the insertion of the above in your next or following Magazine, you will greatly oblige,

Yours, &c.

A Subscriber.

Wakefield, 10th March, 1826.

MISCELLANIES.

The inhabitants of the Western Isles make a fine yellow with the juice of the tops of heath boiled; a dark brown with the roots of the white water lily; a black with the roots of the yellow water *iris;* a fine red, not inferior to that from madder, from the gallium verum, or Ru of the islanders.—*Pennant, part 1st, p.* 244.

The Nile begins to rise eight days after the summer solstice, and in 30 more its current runs into the sea, at the rate of four miles; in 70 more, *i. e.* 100 from the beginning, it attains its greatest height, from 23 to 27 feet 6 inches; if the wind is north at this time, it is very favourable for the country, as it keeps the waters from 10 to 15 days at this height. In 130, from 8th October to 14th February, it descends 16 feet; the Nile leaves from 8 to 10 inches of new soil on the land when wet, but is reduced when dry to between 3 and 4.

The air on the sea coast at Sierra Leone is in general so humid, that salt and sugar can scarcely be preserved in a dry and hard state. Iron is so speedily corroded by rust, that a thick bar of that metal, which has lain on the ground for five or six years, may be broken in pieces with little difficulty, and leather soon becomes mouldy and rots. This moist state of the atmosphere is not experienced at some distance from the sea; and in the interior parts of the country it is said to be common for a man to leave to his son, in good condition and well polished, the musket which he has used for forty years:—average rain 84 inches annually—heat 84°.

NOTICES TO CORRESPONDENTS.

We will thank Mr. Buchanan of Paisley to send us his address, as we wish to write him; we received it on a former occasion, but it has fallen aside.

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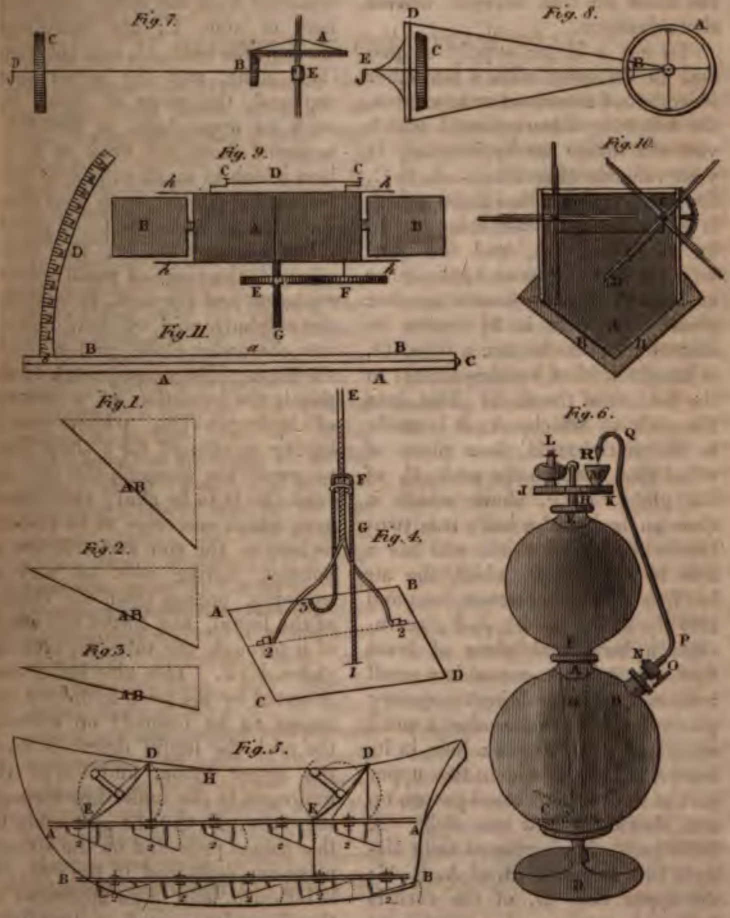
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

"No part of knowledge can attain much excellence without having its foundation laid in Physical Science."—*Bacon.*

No. CXIX. *Saturday, 1st April, 1826.* Price 3*d.*

IMPROVED APPARATUS FOR OBTAINING LIGHT BY PROJECTING HYDROGEN ON SPONGY PLATINUM; INCLINED PLANE STEAM BOAT; HORIZONTAL WIND-MILL, &c. &c.



IMPROVED APPARATUS FOR OBTAINING LIGHT BY PROJECTING HYDROGEN ON SPONGY PLATINUM.

Gentlemen,—On the 3d of April, 1824, I read in your Magazine of that day, the description of an apparatus for procuring a light, by causing a jet of hydrogen to play on spongy platinum. I made an apparatus according to the description alluded to, but found that the supply of gas, in consequence of the form of the instrument, was necessarily very limited, and that the flame on that account was of short duration.

To get a larger supply of gas, and to do away with a few other objections, I contrived an apparatus, the following description of which you will oblige me by inserting in your valuable Magazine:—A, B, C, fig. 6, represents a glass globe, which is 4½ inches in diameter, supported by the stand, D, and furnished with two necks, one at A, the other at B. E, F, represents another glass globe, that is 3½ inches in diameter; to its bottom a tube, G, is attached, that reaches almost to the bottom of the under globe, into the neck of which, A, it is made to fit air-tight; H, is a piece of wood that fits into the neck, E, of the globe, E, F, above which it rises an inch and a half; it is two-tenths of an inch thick, and has a hole in it, through which the air has free exit and entrance from and into the globe, E, F; J, K, represents a horizontal piece of brass that supports on one side a small brass cup, M, containing the spongy platinum, and on the other a small spirit lamp, L; it has a hole in its centre, through which the upper part of the piece of wood passes, up and down which it can slide. A brass cock, N, is ground to fit air-tight into the neck, B, of A, B, C; the upper end, O, of the cock is hollowed out in such a manner as to allow a common sized hydrometer tube, P, Q, to enter it, having a little thread rolled round it to make the joining air-tight. This tube, which is bent in the form represented in the figure, terminates in a brass jet, R.

I have now detailed the construction of the instrument—it is prepared for action in the following manner:—The upper globe being removed from the under one, three bars of zinc, C, are introduced through the neck, B, into the latter. This done, and the upper globe replaced, the piece of wood, H, with its appendage, is next to be removed from the neck of E, F, into which as much sulphuric acid, previously diluted with four times its bulk of water, is to be poured as will nearly fill it; this being effected, the piece of wood is to be replaced, and the cock, N, opened; the sulphuric acid will now descend into the under globe, and surround the zinc. The consequence of all this is the formation of a quantity of hydrogen gas, which process having continued for a short time to expel the atmospheric air, the cock, N, is to be shut; the hydrogen, which continues to be evolved as long as the zinc and acid are in contact, having now no way of escaping, presses upon the surface of the liquid, and forces the whole of it through the tube, G, into the globe, E, F. The zinc being now deserted by the acid, hydrogen gas ceases to be formed: on opening the cock the liquid descends from the upper globe, and forces the hydrogen in the under one through the tube, P, Q; the gas being by this means projected on the spongy platinum contained in the cup, M, is inflamed, and in an apparatus of the dimensions stated, will continue to burn for more than a minute. If the spirit lamp be turned round to the flame, it will be ignited, and burn for a considerable time. A lamp capable of holding two drams of alcohol will give a good light for more than a quarter of an hour; thus affording sufficient time to get and light a candle.

So soon as the acid surrounds the zinc, the formation of hydrogen gas recommences, which again forces the liquid into the upper vessel, leaving the under one filled with it. Thus a magazine of gas is prepared for any future occasion.—The apparatus of which I have given a description will, I think, be found to recommend itself for its simplicity of management, for all that is required to be done to get a light is to turn the cock; and from possessing the double advantage of neatness and utility, "will form an elegant and useful addition to the parlour or bed-room furniture."

Yours, &c.

T. C. G.

Paisley, 16th March, 1826.

INCLINED PLANE STEAM BOAT.

To illustrate the principles of the inclined plane steam boat, let us take, for an example, a board of any superficial extent, and place it under the surface of the water, in an inclined position, at any angle which forms a real inclined plane. To draw this plane vertically upwards out of the water is impossible, for it will be thrown forwards with a force proportionate to the power applied, and the angle to which it is inclined.

Example: Suppose the inclined plane, A, B, fig. 1, void of weight, and placed, at an angle of 45 degrees, under water. The surrounding element acts on the upper and under sides with an equal and contrary pressure. But suppose you apply 100 pounds to lift it vertically upwards, this destroys the equilibrium, and it would rise, advancing forwards, with any weight less than 100 pounds, drawn horizontally; or, in other words, it would require 100 pounds, horizontally, to keep it in equilibrium, or to keep it from rising—for the surface vertical and the surface horizontal are both of equal extent: and as it is this forward motion upon which the whole depends, I will show, by theory, that in whatever situation it is placed, the effect gained is always equal to the power lost. By inclining the plane to 22 degrees 30 minutes, (see fig 2,) where the upper surface is double the horizontal, the same power could only balance one-half: But then the advansive motion would be double that of the other, were it to be lifted to the surface; and, again, at the inclination of 11 degrees 15 minutes, (fig. 3,) which is four time less than 45 degrees, the same power could only drag a fourth part. But in this, again, the motion forwards will exceed it by four times the space.

Thus, by the invariable rule of mechanics, if we gain motion, we loss power, and *vice versa*. It will be observed that there has been no allowance made for the unstableness of water to any pressure, but let it be remembered, that the planes in practice will be but momentary in their ascent and descent, making the time but short for the water's yielding. Likewise they must have a sufficient surface corresponding to the power, or proportioned to the effect to be attained, which proportion, the practical engineer must find by actual trial.

I shall here give a description of a small model I made of the plane, with its manner of action, which, though made for the hand, is a tolerable exact representation, (see fig. 4.) A, B, C, D, is the inclined plane; it is merely a thin board in the form of a rectangle, and the greater the difference of the sides the better. This plane I divide into three equal parts: from C, D, to 1, is one part; from 1 to 2, 2, (which is the centre of motion,) is two parts; and from thence to the front of the board, A, B, is the third part. E, F, G, is an iron stalk or handle, upon which there is a screw, (I used to screw a rod to this to lengthen it when I intended to make any trial.) This stalk branches into two at G, a little above the board, and the two ends pass through two eyes at 2, 2, forming a hinge. From 1 and 3 proceeds two chains, whose other ends are connected to a sliding cap upon the stalk, which cap is raised or lowered by a screw nut, by the screwing of which you may tighten or slacken your chains to give a more or less inclination to your inclined plane.

Its manner of action is thus: Suppose this model sunk in the water, and you are pulling it up. The centre of motion not being in the centre of the board, but at one-third, the water takes more effect upon the two parts than upon the one, and it would rise edge-wise, but the chain, 1, comes into effect at a certain inclination, and determines its risings in an inclined position, which gives it its advansive motion—which motion is more or less, according as the inclination is more or less. Again, suppose you have brought the model to the surface, if you plunge it down, the very same effect takes place; for the water takes effect upon the under side of the board as it did on the upper before, and the centre of motion being at one-third, it dips in the front, while the chain, 3, takes effect as the other did, to determine its inclination in this position also. And while you continue to sink it, it advances the same as in the other case. So, whether ascending or descending, its motions are equal, and in the same direction.

The following is the method I would recommend for practice, as it is very simple, and may easily be understood from what has been already said. A, A, and B, B, (fig. 5,) are two parallel iron bars, to which the planes are fixed, the one being close to the side of the boat, and the other farther off; so that in working alternately up and down, they pass each other freely. These planes projecting from the vessel's sides will be objected to, but as this is merely a trial, improvements of course will follow. 2, 2, 2, &c. the planes, each of which are fastened to the parallel bar by their respective swivels. D, D, and E, E, are working beams that raise and depress the planes. The ends, D, and D, working close to the boat for the bar, A, A, while the other end reaches out for B, B; the rod, H, connects the two working beams in the manner represented in the figure, so that both ends of the parallel bars, by this communication, rise and sink alike. There are two rocking beams that run across the boat to the other side, where there is the same machinery as on this side, only there is no occasion for more than one connecting rod, H, as this one is sufficient for all. Now, the piston rod of the engine, by working a lever upon one of the rocking cross beams, sets the whole in motion; there is no occasion even for a single wheel or crank, a few connecting rods and levers will be all that is required, and the suggestion or beginning of any new invention becomes by succession still more and more simplified and improved. Let us try a theoretical experiment with a sixteen horse power, which can raise a weight of 2025 lb. six feet high per second; say that we have this power attached to the planes alongside the vessel that are inclined to the angle of 10 degrees, or the horizontal surface four and a half times as great as vertical; say that they are six feet sunk, and to be raised to the surface, which may be effected by them, advancing four and a half times six, or twenty-seven feet, and if 2025 lb. or the above power is attached, it will advance at this rate, which is eighteen miles per hour, and meet a constant resistance of the 450 lb. which I consider to be the resistance of the fluid against the head of the vessel. The descending of the planes to the above depth, producing equal effect, renders the vessel's motion constant and uniform. By varying the angle of the planes, we may have a motion of 12 miles per hour, and a power to overcome (with the same engine) 675 lb. resistance of power, and again, at 8 miles, a resistance of 1012 lb.

A vessel containing a 60 horse power engine, may advance 18 miles per hour, with a constant pressure forwards of 1630 lb.

A sailing vessel receiving a constant and uniform pressure forwards, must have a great velocity when her motion has become constant and uniform.

By the adoption of the above method of sailing, a vessel may perform a voyage tolerably well, and be in perfect safety, even in the greatest storm, a thing of great moment, and worthy the attention of men more likely to carry it into effect than

JOHN THOMSON.

Kilmarnock, 20th March, 1826.

HORIZONTAL WIND-MILL.

GENTLEMEN,—Contemplating the manner in which the wind-mill works, I consider that it labours under a great disadvantage, particularly as the wind comes on it obliquely, in the manner it does on the sails of a vessel in going close on the wind. I know not whether the way devised by me for getting the wind to come fair on the sails, is worthy of being called an improvement; but if you think it is worth inserting in your useful Magazine, it is at your service.

Description of the Plate.

Fig. 9 is a section or front view of the whole; A, is a screen for keeping the wind from acting on the one side of each mill; B, B, are the sails of each, for, as one mill would require almost as much to shelter it as two would when the arms work between other, and would only possess half the strength, I have taken two; C, C, are cranks on their shafts, connected by the rod, D, or they might be connected by wheels, so as to have the strength of both; E, a wheel for communicating with the rest of the machinery, and turned by the wheel, F, which is on the shaft of one of the mills; G, is an upright, on which the whole will revolve in turning to the wind, which it will do of itself; *h*, *h*, *h*, *h*, are edges projecting out from the screen, and so will help to direct the wind in a body to the sails.

Fig. 10 is a bird's-eye view of the whole. I intend to have it closed in above, but have shown it open in the plate that it might be better seen; A, is the screen with an angle pointing to the wind; B, B, are the edgings mentioned above; C, C, the arms of the mills; D, the upright, round which the whole will turn to the wind when placed pretty near the front.

Should the above described plan be adopted, or one similar to it, it would not be so liable to accidents, on account of its being so low.

I am, yours, &c.

JOHN WHYTE.

Easdale, 18th January, 1826.

QUERY.

WILL you, or any of your intelligent Correspondents, through the medium of your Magazine, give a description of those vessels or boats called "Catamarans," so unsuccessfully tried at Boulogne, August 1804? By so doing you will greatly oblige,

Yours, &c.

J. WHYTE.

PROGRESSIVE MOTION.

GENTLEMEN,—The plan described below of a horse-driven machine, was communicated to me by a foreigner; in his view it was of the greatest advantage compared to the common method. As it has not been tried in this country, (as far as I know,) the making of it more public may be of advantage.

Description of the Plate.

Fig. 7 is a side view of the whole; A, is a horizontal cog-wheel; B, is a small wheel; C, a wheel, which, in working, describes a circle round it, and, as shown in the plate, will turn six times round its own shaft for each revolution, carrying B along with it, which is on the same shaft, and is one-sixth of the size of A, so that for every revolution of C, A makes two turns; D is the horse draught; E is the socket on the shaft of A.

Fig. 8 is a bird's-eye view of the whole; A, is a cog-wheel; B, a cross piece of the frame, D, in which the shaft of C works, and it turns round the shaft of A, by the socket, E, of fig. 7; and E is where the horse is yoked to the frame, which sets the whole in motion.

If you deem the above worthy of a place in your useful Magazine, and if you or some of your intelligent Correspondents would tell whether it is or is not of advantage besides the common lever, you will greatly oblige,

Yours, &c.

JOHN WHYTE.

Easdale, 9th March, 1826.

INSTRUMENT FOR ASCERTAINING THE INCLINATION OF ANY RISING GROUND.

GENTLEMEN,—If you deem the instrument under described worth a place in your work, the inventor (if such he is) will be gratified by its insertion. It is calculated to ascertain the inclination of any regularly rising ground with great ease. The extreme distance of the acclivity being first known, one application of the instrument will tell its rise. It is of the most simple nature, as will be seen both from the description and sketch.

Fig. 11, A, A, a piece of wood, two feet long from the extremity of the hole in which the scale is fixed—one inch broad, and half an inch deep; B, B, another piece of wood of the same dimensions, into which a spirit level is inserted at *a*, having a hole which slides along the scale, D. These two pieces of wood are jointed at *c*. D, a scale, indicating inches and the ordinary divisions of inches on the one side, and the calculated inclinations on the other in feet, *viz.* 10, 20, &c. up to 100, fixed to A, and passing through a hole in B. The inclination of any given length is easily ascertained. When you want to know the rise of any hill or road, the instrument is merely laid upon it, the end at which the scale is being lowermost; then raise the moveable piece of wood, B, upon the scale till it is level, which is ascertained by keeping your eye on the spirit level fixed in B; this being done, you know the acclivity of two feet, and from this the calculation of any length is easily made.

Yours, &c.

R.

Glasgow, 23d January, 1826.

ON COMMERCIAL IMPROVEMENT.

The difficulties attendant on any improvement in the arts, may be considered either as moral or physical. Under the moral, I would class every thing that relates to the prejudices of men in favour of the old methods, and their fears of risk, together with the economical and commercial inconveniences attending the new processes. The physical difficulties are such as attend the actual performance of any project, after the same has been carefully arranged in the mind of the inventor. It happens unfortunately here also, that the inventor is seldom aware of the moral impediments, but almost always concludes that if he can succeed in accomplishing the purpose he has in view, his cares and labour will then be at an end; and that the manufacturer in particular, instead of pointing out new impediments, discernible only from long continued experiments, will more readily embrace and approve of the new processes, in consequence of his superior knowledge of their intrinsic value.

Every good invention appears simple in the prospect, but it scarcely ever happens in the execution that the most direct read is taken; and in every case there will infallibly be many things unknown or unforeseen, which practice only can point out as necessary to be done for the complete accomplishment of the object in view. Hence, and likewise because few men possessed of independent fortune are likely to engage or persevere in a labour of this kind, it almost invariably happens that the expenses exceed the ability of the inventor himself. For these and other reasons, new undertakings are generally brought forward by the inventor, a man strongly prejudiced in favour of his leading pursuit, together with a monied friend, who hopes speedily to increase his capital from the abilities of the other. It is not necessary, in this place, to describe the usual consequences of a partnership, where the minds, the views, and the circumstances of both individuals are so very different, and which may be modified still more essentially, if either of the parties be deficient in the common principles required to bind men to each other. It is certainly of the highest importance to both, that the circumstances of such connections should be very maturely weighed before they are entered into.

The commercial difficulties or facilities attending any invention are also of great consequence.

Every inventor ought to inquire not only what has been done before, but likewise into the present state of the manufacture he means to improve. In this way it is ascertained how small a part the mere press-work constitutes the price of a book. He will find that twelve yards of paper hangings are printed for one penny, in a single colour, by hand, which afterwards, by the accumulation of price in paper, colour, duty, and ordinary profit, are sold for three shillings; none of which the inventor can pretend to diminish; and if he could annihilate the whole labour, his advantage would be less than 3 per cent. without reckoning the cost and operation of his machinery.

Under these, and similar points of view, the inventor, who may consider the subject in a superficial manner, would be ready to abandon his undertaking. But this, again, ought not to be rashly done. It is true, that where the great force of capital is employed on objects not comprehended within this project, the saving, however large in its absolute amount, or desirable to a manufacturer, will scarcely come within the reach of the inventor by any bargain he can make short of an actual partnership. But it may be possible to separate the respective departments of a manufactory. A spinner is not necessarily a weaver, nor a printer a linen-draper or a dealer in paper hangings. The several departments of manufacture and commerce are, generally speaking, in the hands of acute men, who seldom reason ill with regard to the advancement of their peculiar interests; and these departments are continually fluctuating in their arrangements, as convenience, profit, or the accumulation of capital may lead. Experiments are for ever on foot, from day-work to piece-work, and from piece-work to the employ of master-workmen, with others under them, all supported by the capital of the large manufacturer, who himself, in many instances, is the mere instrument maintained by the advances or acceptances of the warehouseman, the factor, or the merchant. An inventor who has not capital may seek for employ on the goods or the capital of others, and if he has skill to maintain his ground against the numerous enterprises which the activity of opposite interests will raise against him, he will find that the old order of things will readily alter, as soon as an evident interest in favour of the new is shown by actual and continued proofs in the market.

TO PRESERVE PLATED GOODS FROM TARNISHING.

Gentlemen,—Now that plated articles are so common amongst the middling class of the community, perhaps the following invention of mine may be worth noticing in your very useful Magazine. People often complain that these thin plated goods are very soon rendered unsightly, from the copper shining through at all the prominent parts, before they have received much use of them. This arises from these goods tarnishing so much when put past that they require to be brightened every time they are used, thus requiring the same scouring to articles only used once a month, which is given to those belonging to the higher ranks, which are in daily use. To remedy this, after cleaning, wash over the articles with gum water, and dry them before the fire; this gives them the appearance of being slightly matted, in which state, for ordinary purposes, they are fit for being presented to the table. On gala days, wash it off with warm water, and dry with a soft cloth, when the articles will again have the same lustre as when brightened with the plate powder.

This is applicable to those articles only that are not to be wetted. Spirit stands, when done in this way, however, are not injured by having spirits spilt on them, as the gum is not very soluble in spirits. Some may laugh at my simple wash; but I can tell you it is useful.

D. M'D.

Trongate, Glasgow,
21st Jan. 1826.

CHARACTERISTIC DIFFERENCE BETWEEN THE ANIMAL AND VEGETABLE KINGDOMS IN NEW HOLLAND, AND IN OTHER PARTS OF THE WORLD.

Though no very essential difference be perceptible in the moral and physical qualities of the man of New Holland, and the rest of the species, except that which arises from the different circumstances under which they are placed;—though the rocks and mountains, and the earths, resemble nearly the inorganic substances that are met with in other parts of the world, yet there is a very extraordinary, and a distinct characteristic difference in both the animal and vegetable part of the creation, which makes a considerable class of subjects in both these kingdoms peculiar to New Holland. The quadrupeds hitherto discovered, with very few exceptions, are of the kangaroo or opossum tribe; having their hinder legs long out of all proportion, when compared with the length of the fore legs, and a sack under the belly of the female for the reception of the young, of which family, though divided into different genera, there are at least fifty distinct species. They have rats, and dogs of the jackall kind, all exactly alike, and a little animal of the bear tribe, named *womat*, and these pretty nearly complete the catalogue of four-footed animals yet known on this fifth Continent. There appears, indeed, such an apparent affinity of the natural objects in New South Wales, that Dr. White observes, all the quadrupeds are like opossums, all the fish like sharks, and that every part of the land, all the trees, and all the grasses, resemble one another. There is, however, an animal which resembles nothing in the creation but itself—which, being rejected by naturalists from the classes mammalia, aves, and pisces, must, we suppose, be considered as belonging to the amphibia—we mean the Ornithoryncus paradoxus, "a quadruped with the beak of a bird, which is contrary to known facts and received opinions." When the head of one of these beasts was brought to the late Dr. Shaw, of the British Museum, he suspected it as an idle attempt to impose on his judgment, and did not hastily believe that nature had set the bill of a duck on the head of a quadruped; but so it has since proved to be the case.

The birds are no less singular than the beasts, there being black swans and white eagles; the former everywhere in such multitudes as to spoil a proverb that had held good for two thousand years; and their song, if we may credit Mr. Bass, "exactly resembles the creaking of a rusty sign on a windy day." The *Mænura superba*, with its scalloped tail feathers, is perhaps the most singular and beautiful of that very elegant race of birds known by the name of *birds of paradise;* cockatoos, parrots, and parroquets, are innumerable, and of great variety. The mountain eagle is a magnificent creature, but the emu is perhaps the tallest and loftiest bird that exists, many of them standing full seven feet high.

The plants are no less singular than the animals. Of these Mr. Brown has given a very curious and instructive account in his *Geographical and Systematical Remarks*, in the *Appendix to Flinders's Voyage.* He collected nearly 3900 species of Australasian plants, which, with those brought to England by Sir Joseph Banks and others, supplied him with the materials for a *Flora Terræ Australis*, consisting of 4200 species, referable to 120 natural orders: but he remarks, that more than half the number of species belong to *eleven* only of those orders. Of the *Eucalyptus*, or gum-tree, the largest yet discovered, there are not fewer than 100 different species. "The *Eucalyptus globulus* of Labillardiere," says Mr. Brown, "and another species, peculiar to the south of Van Dieman's Land, not unfrequently attain the height of 150 feet, with a girth near the base of from 25 to 40 feet." Of this magnificent genus there are 50 different species within the limits of the colony of Port Jackson. Of the beautiful and elegant *Melaleuca*, Mr. Brown collected upwards of 30 species; all of which, with the exception of the two species the *Leucodendron* and *Cajaputi*, appear to be confined to Terra Australis. The tribe of *Stackhouseæ* is entirely peculiar to that country. Of the natural order of *proteaceæ*, consisting of about 400 known species, more than 200 are natives of New Holland, of which they form one of its characteristic botanical features; the *Banksia*, in particular, being one of the most striking peculiarities of the vegetable kingdom. The *Casuarina*, of which 13 species have been discovered, is another characteristic feature of the woods and thickets of New Holland. The most extensive genus, however, is the leafless *Acacia*, of which there are more than 100 species; and this, with the *Eucalyptus*, "if taken together," says Mr. Brown, "and considered with respect to the mass of vegetable matter they contain, calculated from the size as well as from the number of individuals, are perhaps nearly equal to all the other plants of that country." The *Casuarina* and the *Eucalyptus* are represented as furnishing excellent timber for ship-building, and for all the purposes of domestic furniture, and agricultural implements; and the gum of the *Eucalyptus* is medicinal; of one species it might be employed as pitch. Freycinet says, they procured a resinous substance from the *Xanthorrhea*, which served them to caulk their vessels. The bark of a tree on the Hawkesbury is said to be as efficacious in tanning leather as the oak-bark; and a creeping plant (*smilax*) is used as a substitute for tea. Nutmegs were found by Flinders on the northern coast, but they were small, and had so little of an aromatic flavour, that Mr. Brown gave the plant the specific name of *insipida*. Among the curious productions of the vegetable world is the *Cephalotus follicularis*, or pitcher plant, of which a very correct and detailed drawing is given in the Atlas to Flinders's *Voyage*.

SELF-ADJUSTING CRANE.

Invented by Mr. James Jones.

[Continued from page 51, of the present Volume.]

It will be readily seen that the manner of working the crane to raise a load, is either by the alternate elevation and depression of the lever by hand, as in working a common pump, or by the usual method of turning a winch, *n*, which, by means of the rod, *m*, communicates its motion to the great lever. It will also be seen that the regulator rises in proportion to the intensity of the load, thereby adjusting the length of the lever, so as to produce a near approximation to an equilibrium between the power and the resistance; for if the load raised be multiplied by the number of teeth which the claws pass over at each alternation of the lever, the products will be found to be nearly the same for all loads within the power of the machine.

If, therefore, the parts of the crane are perfectly proportioned with respect to the power intended to be employed in working it, the effect will in all cases approach very near the maximum.

It is to be particularly attended to in practice, that the angle, *a*, *d*, *e*, fig. 1, No. CXVIII. must at all times be more acute than the angle, *e*, *d*, *b*, that is, the angle formed by the rope coming from the barrel to the roller, O, and a line erected perpendicular on the roller, must not contain so many degrees as the angle formed by that same perpendicular and the rope passing from the roller to the gibb, otherwise the regulator will not rise at all; for if the angles are equal, or if *a*, *d*, *e*, is greater than *e*, *d*, *b*, the more intense the strain upon the crane-rope, the stronger will be the tendency of the regulator to retain its vertical position, or rather to turn backwards, thus depriving it of the governing influence it ought at all times to possess over the great lever. An index might be attached to the regulator that would roughly indicate the weight of the load, and doubtless might be constructed so as to show the weight with considerable accuracy.

The parts necessary to lower a load are these: On the end of the barrel is placed a large gripe or brake-wheel, T, which turns freely on the neck of the barrel in one direction, but is prevented from turning the contrary way, by having ratchet teeth cut on its outer face, (as shown by the two projections, *l*, *l*, in the section, fig. 6, No. CXVIII.) which being taken hold on by a click or clicks affixed to the inner face of the great wheel, B, obliges it to take the brake-wheel with it, when it attempts to turn backward. T is a segment of wood fixed firmly to the floor, and into which the brake-wheel, S, is forcibly pressed by the lever, U, U, which, taking its upward bearing by means of the protuberance, V, against the top of the frame-work of the crane, the other end is held down upon the wheel by the action of the weight, W, so that during the operation of raising a load, the brake-wheel stands still, the neck of the barrel turning freely within it, and the click of the one passing without obstruction over the teeth of the other. It will thus be seen, that as the regulator rises or falls, the brake-weight, W, is projected out farther from, or drawn in nearer to the crown of the wheel, by means of the projecting rod, *d*, which, connecting the weight with the sliding fulcrum, obliges them both to partake of the same motion, so that when the sliding fulcrum is in the most favourable situation for raising the load, the brake-weight is also placed on that part of the lever proper to give the requisite degree of pressure to prevent the load from descending. It will also be noticed, that the end of the lever is bent obliquely downward, so as to form an inclined plane; the purpose to be effected by this bending, is the assistance given by the brake-weight to the first rise of the regulator, when the load is but small. As it is evident that the chain-barrel cannot turn back to allow the load to descend whilst the claws remain in contact with the teeth of the wheel, it becomes necessary, previous to lowering, to disengage them from their hold; to effect this, there is placed in the frame-work by the side of the wheel a plate of iron, Y, of a peculiar form, called, from its office, the reliever, turning on a centre-pin, *p*, and moved by the handle, Z. To the end of this handle, is attached a rope, *a*, *a*, which passes over two pulleys, *b*, *c*, in the end of the brake-lever, and hangs down by the side of the winch, so as to be conveniently within reach. The operation of lowering is this: the winch being placed in its lowest situation, the labourer, by pulling the relieving rope, *a*, *a*, raises the handle of the reliever, which, by bringing the two opposite points which are most extended from its own centre-pin into contact with the ends of the two claws, detaches them from their hold on the wheel, as in fig. 2, No. CXVIII. The load would then descend by its own gravity: but the pressure of the weight, W, which is always in action, being exerted to force the break-wheel into the segment, T, produces so great a degree of friction as will effectually prevent its descent, and the load consequently remains suspended, but a stronger pull on the relieving rope, (as the handle of the reliever cannot rise above a certain height,) must necessarily depress that end of the lever, which, changing its fulcrum by losing its bearing against the upper part of the frame at V, exerts less power on the crown of the wheel, and consequently allows the load to descend just as gently as the attendant pleases, and when it is necessary for the rope to be drawn out, preparatory to raising a fresh load, a still stronger pull, by depressing that end of the lever so far as to take its bearing on the staple or cleat, *i*, (more plainly seen at fig. 5, No. CXVIII.) raises the middle part of the lever entirely off the wheel, when a very small power is sufficient to draw the rope out as far as may be required.

After a load has been raised or lowered, and it becomes necessary to detach the ramshead or hook from the load, it would be found almost impossible to do so, in consequence of the regulator bearing with all its weight on the rope or chain, and thus keeping it at its previous degree of tension. To obviate this objection, the following addition has been made; *e* is a leg or prop loosely jointed to the regulator, which, as it rises, draws the end of the prop over the teeth of the rack, into which it takes firm hold when the regulator attempts to descend, thus affording it a sufficient support whilst the load is disengaged; *f* is the rack, being a cylindrical rod of iron having serrated teeth cut all along one side, and turning on pivots at the ends; attached to the rack is the treadle, *g*, (supported by the spring, *h*, as shown in fig. 3, No. CXVIII.) which being depressed by the foot of the labourer at the commencement of each lift, as shown in fig. 2, No. CXVIII. is made to perform part of a revolution, thereby presenting a plane side of the rack upwards, and consequently disengaging its teeth from their contact with the end of the prop, and thus allows the regulator to descend to its original situation.

As, in some cases, it might be desirable to employ more hands than the crane was originally constructed for, it would be necessary to prevent the rise of the regulator beyond a certain height by confining it down to its proper situation by a hook and chain affixed to the floor, that being a more simple method than the addition of more weight; as in this case, (supposing the load to be exceedingly heavy,) a greater degree of power would be required to be exerted on the break when lowering. To effect this, a rope may be attached to the break-weight, *k*, and passing it under a pulley fixed to the floor, brought to the labourer's hand, by which means he might give the requisite degree of pressure; and as it may happen at times that there may be many succeeding loads of nearly the same weight, it might be advisable, after the first lift has brought the regulator to its proper situation, to fix it there by means of the prop, and the hook and chain, thereby preventing the necessity of raising the regulator at each of the remaining lifts which may be of the same weight.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, Teacher of Mathematics, Glasgow.

No. III.

Besides what we have previously enumerated, mathematics are also eminently useful in the various occurrences and transactions of life. To tell you of the advantages of arithmetic, may perhaps be unnecessary, and it would be endless to relate its several uses in private or public business; the regulation and quick despatch of both seem entirely owing to it. What embarrassment and delay would ensue if merchants and tradesmen were obliged to use the Roman method of notation—how difficult the most ordinary operations in numbers would be—and how much more difficult the more complex calculations, such as interest, &c. The principles of arithmetic are necessary to be known, both for private transactions and for public business; by it the merchant must conduct himself who wishes to regulate his trade with perfect prudence; and by it the financier must be guided who would manage the concerns of a nation with honour and advantage. Numbers are also applicable to such things as are governed by no rule, but depend entirely upon chance; the quantity of probability and proportion of it, in any two proposed cases, being subject to calculation. Upon this depend the principles of gaming. One gamester exceeds another in skill in proportion to his greater ability and readiness in calculating the probability of his loss or gain in any proposed case.

The uses of geometry are nearly as numerous as those of arithmetic. It is necessary for ascertaining property, both in surfaces and solids, in surveying or guaging. Land is sold by measure as well as cloth. Workmen are paid for their labour according to the superficial or solid measure of their work; and by geometry distances and heights are measured, plans of estates, or maps of countries are drawn; its use in civil, military, and naval architecture, is extensive, besides its use in mechanics, &c. and other sciences.

From astronomy we have the regular departure of our time in a succession of years, which are regulated by the return of the seasons and the motion of the sun. This is essentially necessary for many public and private matters, which depend upon the seasons, and they upon the motion of the sun. Without a regulation like this, there could be no certain history, and from this cause there is often a confusion in historians who wrote before the exact disposition of the year, and at present among the Turks, whose history and calendar are equally confused. By astronomy we are able to foretell many celestial appearances, and this is necessary for guiding the mariner in his way, and to enable him to determine his distance from any place.

The mechanics have produced many engines, useful for our necessities, or subservient to our convenience. Some of them keep life itself from being a burden. We see the labour of raising great weights, as large stones, &c. made easy by them. We make the wind or water work for us, and save money and animal exertion. It has been supposed that the steam engines in Britain perform the work of three millions of men, at the daily expense of twopence each. The instruments for measuring time, are ingenious and useful; now we are used with them, we could not easily conceive how many private concerns could be managed without them. By machines of this kind we have imitated the motions of the planets, and by this means show their places nearly at any required time.

To this branch may also be referred the construction of mathematical instruments, the instruments for making observations by land or sea; which are necessary for practising the precepts which mathematical science gives, whether for surveying, gauging, or astronomy.

To the science of optics we are indebted for several of the means of extending our knowledge, and for improving the powers of our vision. By the telescope we can not only descry distant terrestrial objects, but by its means have discovered new parts of the creation, and found new reasons for admiring the wisdom of its author; by its means the true system of the world, has been shown to the senses, and observations on the heavenly bodies can be more accurately made than before its invention. The resulting improvements in astronomy have produced correspondent advances in geography, and indeed an improvement in any branch of mathematical science, is an advantage to them all. The microscope enables us to view the more minute operations of nature, and shows us objects which, without its aid, could never have come within the sphere of our knowledge. These are great advantages, but a greater remains to be mentioned. Those who are nearly blind, whose eye has scarcely strength to distinguish at the distance of a few feet, by means of optical glasses adapted to the defect, can be made to enjoy the blessings of sight. And by the same means, we can render more sufferable the decays of our frame, and preserve a source of intelligence and pleasure to venerable old age. It is remarkable that the only senses which it is in our power to improve, seeing and hearing, are the only ones which can be considered in a mathematical manner, and are perhaps those whose want would be the most painful.

Mathematics are highly serviceable in military affairs. They are necessary in fortification, in defending fortified places, and in attacking them. The method of directing artillery to a mark, and of forming guns, balls, and bombs, depends upon mathematical principles.

MISCELLANIES.

Distillation from Carrots.—Twenty bushels carrots will make three gallons of spirits, something above proof. The carrots are well washed, and stewed in a large copper, then squeezed in a common press; the juice is moderately boiled and fermented in the usual way, and then distilled.

On the utility of Learning.—The pleasure which results from our search after useful knowledge will be found as much superior to that arising from the meaner enjoyments of our senses, as man is above the other orders of animated matter. As we are distinguished from them by the possession of reason, let us cultivate and improve that reason as much as possible; by this mode of proceeding we shall not only employ our time to advantage, which might otherwise lie heavy on our hands, but we will likewise *increase* our time, which we usually think too short. An active man lives twice longer than a lounger, though they should both die at the same age.

The man who is possessed of knowledge, if unfortunate in society, if deprived of almost every enjoyment in life, has sufficient in his power to make him happy; and when old age has rendered him unfit for every other enjoyment, has something still left to render life agreeable. Nor is this all, knowledge makes a person's company agreeable, it prevents its possessor from being imposed upon. And as Socrates says—in prosperity it is an ornament, and in adversity it may be a mean of support.

In Jersey and Guernsey they use sea weeds for fuel: they are prohibited from collecting it, except for three or four days in the year, when all the peasantry assemble with carts, &c. and collect it, lay it out to dry, stack it, and cut it into cakes about the size of a peat for burning; the ashes are good for grass lands.

How to make a Horse lie down in a Stable.—Tie a piece of string about his tail as tight as possible, without breaking the skin, and as near as possible to the rump bone; this will give him pain in the back, and he will be glad to change his posture to get ease; and when he finds he cannot in any other way procure it, he will lie down, which, finding the easiest, he will continue to practise, and he will take a liking to it.

The earth when in the perihelion, is six millions of miles nearer the sun than when in the aphelion; the centrepital force is increased $\frac{1}{15}$th, to counteract which, the centrifugal force carries it over 61′ per day, instead of 59′, her mean motion. This increased motion, and the combined forces, generate an increase of the tides, and accumulate a body of waters towards the parallel of latitude which lies in the direction of the forces. Hence so vast a collection of waters at the south pole, the perihelion force being in the 23° south latitude. The difference of two consecutive perihelions is 1′ 2″, making 1° 43′ in 100 years; 30° in 1744 years; 90° in 5233, and 360° in 20931 years.—Hence in every 5233 years, a great change is produced.

The present epoch will last till the north point comes to $11\frac{1}{4}$° of south dec.

that is, through 4 signs, or 6977 years, of which, as it is now in 9½° of west, 4070 years have already passed; so that no considerable change has taken place since 2258 B. C. *i. e.* near the time of the deluge in 2318, B. C. and none will take place till the year 4716.

The second epoch is from 11¾° north the equator in 1744 years, *i. e.* between 4719 and 6463. The past one happened 4002 B. C. (near creation.) The third epoch is from equator to 11¾° north, from 6463 to 8207. The past one happened 5746 B. C. The fourth will last as long as the present, or 6977 years, from 8207 to 15284. The past one happened 12723 B. C.

These revolutions carry the waters with them, and overwhelm alternately the north and south hemispheres. Another motion, the decrease of the obliquity of the ecliptic, at the rate of 52″ in 100 years, produces 1° in 6923 years, so that Britain might have been, 149,000 years ago, in the same relation to the Tropics as Morocco in our days.

Education in Russia.—There are six universities in the Russian empire. The cities in which they are established, are Moscow, Petersburgh, Casan, Dorpat, Cherkof, and Wilna. The natives of Russia are not allowed to go and study in a foreign country, until having attended for at least three years one of the Russian universities. Nevertheless, the chairs are few in number, several subjects are entirely interdicted, and the vigilance of the censorship cramps the professors in treating those which are allowed. The students are under all kinds of restraint, especially at Dorpat and Wilna; where, indeed, disorders have occasionally taken place which required the interference of authority. The young Russians are not admitted into the military service until they have undergone an examination at one of these universities. That of Dorpat is principally attended by youth from the three Baltic provinces; and German is there the prevailing language.

Magnetic Equator.—The magnetic observations made by Captain Duperrey, of the Coquille sloop of war, which sailed from Toulon on a voyage of discovery in August 1822, and returned to Marseilles in April last, are numerous and interesting. Every body knows that there are on the surface of the globe, a number of spots where the compass ceases to point, and that a line drawn through those spots is called the magnetic equator. This equator must not be confounded with the terrestrial equator, round which it winds, as it were; sometimes passing to the north of it, and sometimes to the south, to a greater or less extent. In the course of his voyage, Duperrey crossed the magnetic equator six times; and the result of his observations renders it extremely probable, that the whole line is moving parallelly from east to west, with such rapidity, that since the year 1780, when its position was ascertained by scientific men in a very satisfactory manner, it has advanced no less than 10 degrees towards the west.—*French Paper.*

To make leather more durable, and less permeable to water, it is proposed to have the flesh side of the sole out: before it is put on, the whole hide is heated, and the flesh side is coated with tar, and kept hot till it soaks it in, and then drys, when it is to be repeated several times, till the tar has penetrated to the opposite surface. In the last application, to render it more durable, it is powdered with steel filings. The shoes may be smeared on the soles occasionally.

Cooling of Glass.—Bellani finds, that after glass has been exposed to a great heat, on cooling, it never regains its original volume.

Artificial Cold. — Brugnatelli informs us, that spirit of wine, æther, &c. mixed in certain proportions with snow, afford temperatures as low as those produced by sea-salt.

NOTICES TO CORRESPONDENTS.

We shall be glad to hear from J. T. G. with an account of the improvement in line engraving he mentions; and it will be inserted if found to be, as he says, new.

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"Facts often appear incredible, only because we are ill informed, and cease to appear marvellous when our knowledge is farther extended."—*Playfair.*

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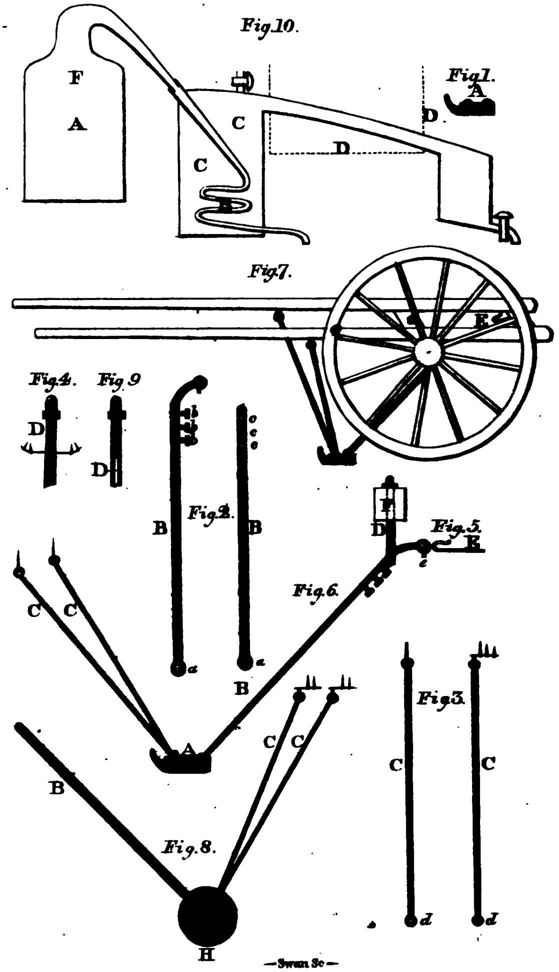
METHOD OF PREVENTING ACCIDENTS FROM HORSES FALLING WITH TWO-WHEEL CARRIAGES; MEANS OF PRODUCING DOUBLE DISTILLATION BY THE SAME HEAT.



METHOD OF PREVENTING ACCIDENTS FROM HORSES FALLING WITH TWO-WHEEL CARRIAGES, ESPECIALLY ON STEEP DECLIVITIES.

By William Bush, Essex.

Mr. Bush's invention consists of an apparatus made of iron, or other fit material, which he calls a sledge or sliding sole, or a safety wheel, (when a wheel is attached,) and which is constructed in the following manner:—

Fig. 1, A represents what is properly the sledge or sliding sole, having two pivot holes to allow the back and fore braces (which will be immediately described) to be attached to it with the action of joints or hinges. This should be turned up at one or at both ends, to prevent its burying itself in the road, and should be from three to six inches broad, and from eight to twelve inches long.

Fig. 2, B or B represents the back brace, having the pivot hole, *a*, by which it is attached to the sledge or sliding sole, by means of a pin passed through both, and properly secured in its place. *b, b, b,* are catches, to allow the sledge or slider to be brought into action at a height suited to the height of the horse. These catches may be of any form that will lock them in an eye (described hereafter) attached to the middle of the axle; or, instead of these catches, holes, *c, c, c,* may be pierced through the brace, into which a pin may be put to keep the back brace in its place. To this is joined a ring or hook, *e*, shown on fig. 6, to be hooked on fig. 5, when the apparatus is not in action.

Fig. 3, C, C, the two fore braces, having also pivot holes, *d, d,* to attach them to the sledge or sliding sole. The other ends have a ring and bolt, to attach them to the shafts by a screw and nut, or they may be nailed to the shafts, or made fast to them in any workman-like manner.

Fig. 4, D is the eye which receives the back brace, and which is made fast to the middle of the axle. The eye or opening is shown by D, fig. 9.

Fig. 5, E is an iron hook, which is fastened to the hinder part of the carriage on which the ring, *e*, of the backstay, (see fig. 6,) is hooked when the apparatus is kept up from the road or out of action.

Fig. 6 shows the sledge; A, the back brace; B, the hook or ring; *e*, the fore braces; C, C, all united, and the back brace passing through the eye, D, made fast to the axle, F, shown in section.

Fig. 7 exhibits the apparatus attached to a carriage, and in action, that is, with the sliding sole on the road.

Fig. 8 shows the apparatus with one small wheel, H, (or two small wheels,) substituted for the sledge or sliding sole, A.

In the foregoing figures the same letters refer to the same or similar parts; and from the parts viewed separately and joined, no competent workman will be at a loss how to execute the invention.

From inspection of these figures, the mode of the action of the apparatus may also be clearly seen. When the carriage is to be supported, and the horse's back relieved from the load, the ring, *e*, of the back brace, B, is to be unhooked from E, (figs. 5 and 7.) And the said brace is to be moved forward through the eye, D, (figs. 4 and 9,) till the sledge or slider, A, or safety-wheel, H, (fig. 8,) takes the ground; and the corresponding catch or hole, with its pin, is to be made sure in the eye, D, (figs. 4, 6, 9,) by which means the shafts and loads will be borne up from the horse's back, and security be provided against his being thrown down by the weight of his load when descending a hill. These different parts may be altered in form, provided the workman keeps in view the end intended to be gained, and adapts all the different parts properly to each other, and to the work they are to perform.

ON THE MEANS OF PRODUCING DOUBLE DISTILLATION BY THE SAME HEAT.

THOUGH water may, by means of steam, be brought to the boiling point, it cannot in the ordinary process be raised above it—and, therefore, cannot be converted into vapour so as to pass over by distillation. As soon as the steam has imparted to the water its own temperature, there is no longer any transfer of heat, and the steam passes through the water uncondensed.

If, on the contrary, the steam did continue to condense, the water would itself be converted into steam, and might by that means be distilled over without any additional fire; and though this does not take place under the usual circumstances, yet it may be effected in the following manner:—

The temperature required for converting any fluid into vapour is dependent on the pressure of the air upon its surface, and may therefore be lowered if that pressure is diminished. If, then, the weight of the air was removed from water, it would rise into vapour below the common boiling point, and might therefore be distilled over by steam of the usual heat.

In order to produce this effect, a vessel, having a receiver connected with it, should be made air-tight, and the steam made to pass through the vessel along a worm or spiral tube of metal, in the manner represented in the outline (fig. 10) of the plate. The vacuum is now easily produced by applying heat to the vessel till the steam issues from the opening in it, and in the receiver, when they are to be immediately closed, and the heat removed.

The water distilled over is collected in the receiver, which is kept cool for that purpose.

An apparatus of this kind was constructed by Smithson Tennant, Esq. chiefly for the purpose of explaining the theory of latent heat, or of the capacity of bodies for heat in different states; but it is possible that it may also be applied to practical use, where it is of consequence to economise the consumption of fuel. When water is deficient on board of ship, it has been in some degree supplied by distillation from the ship's boiler; and if, in such cases, the steam from the boiler were made to pass through such an apparatus, the quantity would be nearly doubled.

By experiments made by Mr. Tennant with his apparatus, about three-fourths of the quantity obtained by the first distillation were added by the second. But it is believed a larger proportion might be procured were the second distilling vessel coated with flannel, or some other non-conducting substance, to retain the heat.

A, F, is the first boiler and head; B, the worm, extending to C, the second boiler; the dotted lines, D, D, represent the situation of the cooling vessel to be used for condensing the steam arising from the second boiler.

ON THE CORAL REEFS AND ISLANDS OF AUSTRALASIA AND POLYNESIA.

THROUGHOUT the whole range of the Polynesian and Australasian Islands, there is scarcely a league of sea unoccupied by a coral reef or a coral island; the former springing up to the surface of the water perpendicularly from the fathomless bottom, " deeper than did ever plummet sound," and the latter in various stages, from the low and naked rock, with the water rippling over it, to an uninterrupted forest of tall trees. " I have seen," says Dalrymple, in his Inquiry into the Formation of Islands, " the coral banks in all their stages; some in deep water; others with a few rocks appearing above the surface; some just formed into islands, without the least appearance of vegetation; others with a few weeds on the highest part; and lastly, such as are covered with large timber, with a bottomless sea at a pistol-shot distance." In fact, as soon as the edge of the reef is high enough to lay hold of the floating sea-wreck, or for a bird to perch upon, the island may be said to commence. The dung of birds, feathers, wreck of all kinds, cocoa-nuts floating with the young plant out of the shell, are the first rudiments of the new island. With islands thus formed, and others in the several stages of their progressive creation, Torres' Strait is nearly choked up; and Captain Flinders mentions one island in it covered with the *Casuarina*, and a variety of other trees and shrubs which give food to paroquets, pigeons, and other birds, to whose ancestors, it is probable, the island was originally indebted for this vegetation. The time will come, —it may be ten thousand or ten millions of years, but come it must, —when New Holland, and New Guinea, and all the little groups of islets and reefs to the north and north-west of them, will either be united into one great continent, or be separated only with deep channels, in which the strength and velocity of the tide may obstruct the silent and unobserved agency of these insignificant but most efficacious labourers.

A barrier reef of coral runs along the whole of the eastern coast of New Holland, " among which," says Captain Flinders, " we sought fourteen days, and sailed more than 500 miles, before a passage could be found through them out to sea." Captain Flinders paid some attention to the structure of these reefs, on one of which he suffered shipwreck. Having landed on one of these new creations, he says, " We had wheat-sheaves, mushrooms, stag's horns, cabbage leaves, and a variety of other forms, glowing under water, with vivid tints of every shade betwixt green, purple, brown, and white." " It seems to me," he adds, " that when the animalcules, which form the coral at the bottom of the ocean, cease to live, their structures adhere to each other, by virtue either of the glutinous remains within, or of some property in salt-water; and the interstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is at length formed. Future races of these animalcules erect their habitations upon the rising bank, and die in their turn, to increase, but principally to elevate this monument of their wonderful labours." He says that they not only work perpendicularly, but that this barrier wall is the highest part, and generally exposed to the open sea, and that the infant colonies find shelter within it. A bank is thus gradually formed, which is not long in being visited by sea-birds; salt-plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandanus, is thrown on shore; land-birds visit it, and deposit the seeds of shrubs and trees; every high tide and gale of wind add something to the bank; the form of an island is gradually assumed; and last of all comes man to take possession.

If we should imagine one of these immense coral reefs to be lifted up by a sub-marine volcano, and converted into an insular or continental ridge of hills, such a ridge would exhibit most of the phenomena that are met with in hills of limestone.

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OIL PAINTINGS:—COLOURING.

In the "Annals of National and Foreign Industry," a Parisian publication, there has recently appeared a paper communicating the result of some interesting experiments made by a M. Coulier, with a view to contribute to the preservation of pictures painted in oil. He attributes the change that takes place in the colours principally to the action of sulphuretted hydrogen gas, which, as it is well known, darkens the carbonate of lead as soon as it comes in contact with it. On this subject, the Revue Encyclopedique has the following remarks:—

"We are of a different opinion, and we refer, in support of it, to the brilliant pictures of the Dutch school. The thin coat of varnish with which they are covered, has been sufficient to defend them from the exhalations of the canals, which nevertheless in several places leave, in a few hours, visible marks of their emanation on copper and on silver. The cause of the change of colours supposed by M. Coulier, has necessarily had an influence on his labours. Accordingly, the first object of his researches has been to discover a white less susceptible than our carbonates of lead of being darkened by hydro-sulphurates. He believes that he has accomplished this object by decomposing the acetate of lead by means of weak muriatic acid. This submuriate, brought into contact with sulphuretted hydrogen gas, does not sensibly lose its whiteness; while the finest carbonates of lead of the shops, even those which are improperly called 'whites of silver,' become dark in a few moments. If this white really possesses all the properties which its inventor, after many experiments, attributes to it, it will no doubt be of great use in the arts. It is for painters to determine that question, and we advise them not to limit their experiments to those made with the sulphuretted hydrogen gas. We do not doubt the accuracy of those experiments, but they are insufficient to establish the very important fact of the action of this submuriate of lead on oils. It is several years since it was proposed to employ sulphate of lead. We believe, with M. Coulier, that it was preferable to the carbonates, because it was less liable to change by hydro-sulphuric vapours, and because it had been calcined. It was tried in various ways, and it was established that even this white, besides working ill, became in a little time of a dirty yellow hue; an effect which was attributed to the rancidity produced in the oil, by the re-action of the sulphuric acid. The theory is not yet far enough advanced to warrant any confidence in reasonings solely founded on analogy. If M. Coulier had simply made on his palette mixtures of vermilion and white lead, he would have immediately recognised their identity with the tints in Rubens's pictures; and he would not have stated that carbonate of lead is decomposed and transformed into dark sulphur when brought in contact with vermilion. But, although there should not be found in M. Coulier's white the qualities he predicts, his exertions do not the less deserve the gratitude of the lovers of the fine arts; and we trust he will persevere in his useful labours; at the same time advising him, both for the interest of the arts, and for his own, to begin by ascertaining from painters themselves what are their *desiderata*. They will tell him that it is not in the lights that their pictures undergo the greatest change; and the instructions which he will receive from them will, we doubt not, give a better direction to his researches."

ESSAYS ON BLEACHING,

By James Rennie, A. M. Lecturer on Philosophy, &c. &c., London.

No. IV.—CHEMICAL AND PHYSICAL NATURE OF STUFFS.

3. *Cotton.*—This substance is a down contained in the pods of the *gossypia* of Linnæus. This down is different in the different species, both in fineness and colour. In most it is white, of different shades; but that from which the nankin is made is what Werner would call Sienna yellow or bufforauge: a sort is mentioned as growing in Dahomy of a bright yellow; and several kinds, having different shades of red, have been described. The coloured sorts, however, are not common, and the chief difference between one sort and another, seems to consist in the length, tenuity, and strength of the filaments. Naturalists do not seem to have ascertained with accuracy the structure of these filaments. The microscope, according to Lewenhoeck, shows that they have two sharp sides. It certainly possesses some kind of asperities, or how can we account for the irritation which it produces when used in dressing wounds? In this it is totally different from lint. Perhaps this irritating action may be accounted for from the filaments being shorter than those of flax, and consequently presenting a greater number of points on the surface of the cloth. Dr. Thomson found the specific heat of cotton to be 0.53, that of water being 1, but from the difficulty of ascertaining this, he does not state it with confidence. (Ann. of Phil. II. 27.)

We learn something of the composition of cotton from Mr. Mushet's experiments on dry distillation. (Phil. Mag. XXXIII. 9.) He distilled 263 grains of the cloth which had been previously bleached. It emitted, during the operation, a quantity of pale blue flame, and left, as a residuum, a light friable coal, possessing the original shape and texture of the cloth, which weighed 39 grains—loss, 124 grains. It appears, then, that a hundred parts consisted of 85.16 volatile matter, and 14.84 of oxyde of carbon; being 16.16 less carbon than is contained in as much silk, and 9.05 less than exists in pure wool.

The fibres of cotton, according to Nicholson, (Dict. of Chem. art. vegetables,) are insoluble in water, in alcohol, or in ether; but soluble in alkalies. It follows, of course, that strong alkaline leys will injure the texture of cotton goods in the process of bleaching. When treated with the nitric acid, cotton yields the oxalic There seems to be in cotton, none of that particular resinous kind of matter which constitutes or contains the colouring matter of unbleached linen.*

4. *Linen.*—The mode of preparing flax, for the linen manufacture, has already been cursorily mentioned, when treating of water, and I shall not repeat what was then stated. The flax, when taken from the field, is put into ponds of standing water to steep, and stones are laid above it, to keep it from floating. When no such ponds are to be had, it is put into those parts of running water where there is little current, or little streams are banked up for the purpose. None of these, however, answer so well as ponds, for the process is both more tedious and more uncertain. The intention of steeping is to dissolve the oily or mucilaginous substance which makes the bark adhere to the woody part of the flax, and thus to effect a separation of the latter. This intention is answered by putrefactive fermentation, which steeping induces, for it renders the oil and the mucilage soluble in water. It requires some nicety, however, to know when the putrefactive process has accomplished its purpose, for the flax will be equally useless if it has been steeped much or too little. In the one case the fibres will not be separable, or black bars in the linen will be the consequence, whose numbers increase with the deficiency in steeping, and which in bleaching are very difficult to remove. In the other, they will be destroyed, or very much weakened, by losing their tenacity. Now, the length of time which flax has been in the pond can give no criterion of this, for the putrefactive fermentation depends much on other circumstances, such as the nature of the flax, its quantity, the heat of the weather, the length of the nights, the pressure of the stones laid upon it, and the quality of the water. The quickness or slowness of the fermentation, then, must be the measure of the time of steeping. On the second or third day, when the weather is warm, a great many air bubbles arise to the surface of the water, and a scum or pellicle is gradually formed. The temperature of the water increases and it acquires a corrupted smell. The flax ought to be inspected every six hours after the fourth day; and as soon as a glutinous or oily matter is perceived on the outer bark,

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* Des Charmes, however, (p. 106,) ascribes to such a resin, or to an oil or a gum, existing in cotton, the difficulty with which it imbibes water. Des Charmes remarks also, that though it may not appear foul, yet it never fails to render by its impurities the water in which it may be macerated of a darkish colour. As it imbibes water with difficulty, it also retains it with some obstinacy, and before bleaching is found to be long in drying. This may be countenanced by an observation of Mr. T. Henry's, (Man. Mem. iii.) that it imbibes water much more readily after it has been bleached than before.

and when this separates easily from the woody part, it ought to be taken out. But it ought not to lie till this separation becomes too easy, as this will be better completed by exposing it to the dew. Steeping ought always to be performed in a place much sheltered from the winds, as the process is checked by nothing so much as by agitation and cold, while it is greatly promoted by quietness and heat. For this reason also, the ponds ought not to be too shallow, as in that case they are more liable to be affected by changes of temperature. The flax ought not to touch the bottom of the pond, otherwise what is below will perhaps be rotten, in consequence of the superincumbent pressure, before that at the surface is nearly watered. This process appears, then, to be extremely difficult in management; and by it is produced a great deal of that brown colouring matter, which it is the object of the bleacher to remove.* Mr. Lee's method of preparing flax, which has been before stated, is not liable either to difficulty of management, nor to its injurious effects, and bids fair to supersede the process of steeping altogether.

The nature of the colouring matter of brown linen, whether it exist naturally in the flax, or be acquired by steeping, has been accurately investigated by Dr. Kirwan, in the Transactions of the Royal Irish Academy, Vol. III. He made his experiments upon ley, saturated with this matter, which he procured from the bleachers. This liquor was turbid, of a reddish brown colour, having a strong smell, and exhibiting no indication of acidity or alkalescence. It did not effervesce with the muriatic acid, but afforded with it a copious precipitate, leaving a supernatant liquor of a red amber colour. When this is drawn off by a syphon, and the precipitate treated pretty copiously with water, agitating the whole, and again allowing it to subside, the floating liquor exhibits evident signs of acidity, and continues reddish, giving room to suppose that it contains a peculiar acid. After copious effusions of cold water, and when the precipitate is thrown on a filter and suffered to dry partially, it is of a dark greenish colour, and nearly of the consistence of moist clay. This was not dissolved when treated with sixty times its own weight of boiling water. If dried in a sand heat, it assumes a shining black colour, but when broken, shows a greenish yellow fracture, and becomes more brittle. On this the following experiments were made:—1, Having digested a portion of it in rectified spirit of wine, it communicated to it a reddish hue, and was in a great measure dissolved; but by the effusion of distilled water, the solution became milky, and a white deposite was gradually formed: the black matter dissolved in the same manner. 2, Neither the green nor the black matter was soluble in oil of turpentine, or linseed oil by a long continued digestion. 3, The black matter being placed on a red hot iron, burned with a yellow flame and a black smoke, leaving a carbonaceous residuum. 4, The green matter being put into the sulphuric, muriatic, and nitric acids, communicated a brownish tinge to the two former, and a greenish to the latter, but did not seem in the least to be diminished. We infer from this, that the matter extracted by the alkalies from brown linen, is a peculiar sort of resin, differing from the pure resins only by its insolubility in essential oils, and agreeing in this respect with lacs. In examining the action of alkalies on this matter, 8 grains of it were digested in a solution of crystals of soda, saturated to the temperature of 60°, which instantly communicated to the solution a dark brown colour; two measures, each of which would contain 11 dwts. of water, did not entirely dissolve this substance. Two measures of mild vegetable alkali dissolved the whole. One measure of caustic soda, of the specific gravity of 1.053, dissolved nearly the whole, leaving only a white residuum. One measure of caustic potash, of the specific gravity of 1.039, dissolved the whole. One measure of liver of sulphur, (sulphuret of potash or soda,) whose specific gravity was 1.070, dissolved the whole. One measure of caustic volatile alkali, dissolved also a portion of this matter. Three ounces of the solution of Windsor soap, dissolved 8 grains of the colouring matter. It was found also that 4.2 grains of the saline substance of kelp, produced the same effect as 75 of that from Dantzic pearl ash, 38 of that from barilla, 15 of that from cashup, and 213 of soap. The sulphuret of lime was found to act very feebly on it. It follows from these experiments, that sulphuret of potash or soda, is of all the alkaline compounds the strongest solvent of the colouring matter; next to this the caustic vegetables, and after this the caustic mineral alkali; the mild alkalies occupy the least place. Hence, the solutions of kelp, cashup, and markoff, are advantageously used in the first processes of bleaching, for which Dantzic ashes and sweet barilla are less fit. The experiments, however, show that six tons of kelp will be necessary to produce the same effect as one ton of cashup.

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* With regard to colours so produced, Chaptal has made a general remark of some importance, namely, that all colouring matter, arising from fermentation, are less soluble in water than in alkalies. He illustrates this by referring to the well-known dye-stuffs, indigo, woad, and annotta. Boiling water dissolves only a ninth part of its weight of indigo; woad communicates very little colour to water; and annotta can scarcely be dissolved in it at all without the aid of an alkali. Water, then, it will follow by analogy, confirmed, as we shall immediately see, by experiment, will have but little effect on the colour acquired by flax in the putrid fermentation induced by steeping.

It was found by Mr. Mushet, that flax contained more carbonaceous matter than cotton. His experiments were made by dry distillation. When he treated 397 grains of flax in this way, after a copious discharge of white flame, a soft inflammable coal was left as a residuum in the retort. The original vegetable fibre remained entire, and equally compact as to form and bulk as when introduced. It weighed 65 grains, having lost by the process 332 grains. A hundred parts are therefore composed of 83.62 volatile matter, and 16.38 of oxyde of carbon. (Phil. Mag. XXIII. 8.)

ANDERSON'S INSTITUTION.

To the Hon. the Lord Provost
of the City of Glasgow.

My Lord,

You will no doubt be surprised that you should be addressed by one whose avocations are of a nature so different from that of wielding the pen, and who is therefore quite unacquainted with the formalities requisite in addressing one who holds such a high and honourable office as your Lordship; yet, as "I will a plain unvarnished tale deliver," concerning a subject of much importance to the city of Glasgow, and more particularly to that body of its inhabitants whose occupations accord with my own, I trust your Lordship will condescend to give this letter a candid and impartial perusal.

Your Lordship is aware, that in 1795, the late John Anderson, A. M. Professor of Natural Philosophy in the University of this city, bequeathed to the public of Glasgow a valuable Library, Museum, and Apparatus, for the purpose of founding an Institution, in which "Lectures on Natural Philosophy and in every branch of knowledge," should be delivered, and be within the reach of all classes of the community. This property was placed under the direction of eighty-one Trustees, chosen from nine different classes of the community, for the purpose, no doubt, of creating a more extended interest in its support. But there is one particular appointment with which I fear you Lordship is entirely unacquainted, and it is for the purpose of calling your attention to this part of the Professor's Will, that I have presumed to address you in this public manner. The Institution is one which belongs entirely to the public, and, therefore, they ought to know something concerning its progress, present state, and management.

After having appointed the eighty-one Trustees, who are to have the general superintendence of this Institution, he proceeds to appoint another body, who are to have a more particular superintendence of, and control over the Institution, its Trustees, Professors, and servants, as well as over its whole property, and are invested with a power to order and enforce observance of their orders regarding its management.

The following are the clauses appointing this body:—

"*Article Fourth.*—Besides these eighty-one persons, in whom all my property of every kind, except what is in the painted chest with the three locks, is hereby vested for the use of the public, there shall be nine visitors of the conduct of the said eighty-one Trustees, *viz.* the Lord Provost of Glasgow, the eldest Bailie of Glasgow, the Dean of Guild there; the Deacon Convener of the Trades' House, the Preses of the Faculty of Physicians and Surgeons there, the Dean of the Faculty of the Procurators there, the Moderator of the Synod of Glasgow and Ayr, the Moderator of the Presbytery of Glasgow, and the Moderator of the Presbytery of Dumbarton, all and each of them for the time being. Any six of these nine, all the rest being duly summoned, shall constitute a quorum, who are hereby vested with the power of calling for the records of the eighty-one Trustees, and of the Committee of Ordinary Managers afterwards mentioned, of inspecting the apparatus and property belonging to the Institution; and, where they observe any thing managed not agreeably to the intention of the Founder, or to the advantage of the Institution, to correct the mismanagement by their orders, and to enjoin and enforce faithful administration."

"*Article Tenth.*—I direct and appoint, First, That the Ordinary Managers and Visitors shall be summoned to each of their meetings by a written notice, specifying the place, day, hour of meeting, with the heads of the business to be transacted, and not less than forty-eight hours, nor more than one hundred and ninety-two hours before the meeting. Secondly, That the summons shall be given upon the application of any three of the Ordinary Managers to the President of the Ordinary Managers; and by any three of the Visitors to the Lord Provost, who is President of the Visitors. In case of sickness, or in the absence of the President of the Ordinary Managers or Visitors, the next in seniority of the Managers, and the eldest Bailie, or Dean of Guild, and so on of the Visitors, shall act as President. Thirdly, These meetings are vested with the power of adjourning themselves from time to time, and of calling *pro re nata* meetings; and all questions in any of these meetings, excepting as provided in the following article, shall be decided by a majority of the members present, and by ballot."

"*Article Thirteenth.*—I ordain and appoint my said Trustees and Executors, or such of them as shall accept, to apply to the City Council of Glasgow for a Charter, or Seal of Cause, erecting and constituting the said Trustees and Ordinary Managers, and Visitors, into a Corporation and Body Politic, for the more effectually vesting in the Trustees the property of the subjects hereby conveyed and bequeathed; and communicating to them and to the Visitors legal powers of administration, and of check and control, for the benefit and advantage of the Institution."

The knowledge of this appointment, I have little doubt is new to your Lordship, and it will on that account be the more interesting to you. Your predecessors were, I am led to believe, equally unacquainted with their connection to Anderson's Institution, so that whoever may incur blame, neither they nor your Lordship can be found fault with.

The Institution was opened, and incorporated by the Magistrates in 1796, now thirty years ago; yet during that long series of years, if my information be correct, the Visitors appointed in the foregoing clause have never once been called upon to perform their important duty to this useful public Institution. I would beg leave to ask your Lordship how many other Institutions in this city, with which the chief magistrate is officially concerned, have remained unnoticed by him for so many years? How many Institutions have, by his patronage and assistance, been raised to the highest rank of usefulness? And I would ask if any one of these Institutions have been calculated to do more good than Anderson's Institution? Yet it is a melancholy fact, that an Institution which has afforded the means of scientific education at a cheap rate, throughout the long space of thirty years, to thousands of the working classes in Glasgow—which has completely changed the character of the working classes of society—which has rendered our mechanics celebrated over the world for their abilities—which was the first in the world to point out the now acknowledged truth, "that mechanics may be philosophers,"—is unnoticed and unpatronized by those whose protection it might have expected, and who are, in fact, its appointed guardians.

I am most unwilling to throw blame upon a body of gentlemen so respectable as are the Trustees of Anderson's Institution, but I am forced to confess, that, in my opinion, a great deal of the blame must lie upon their shoulders.—They have been appointed to take the management of an Institution which has for its object the dissemination of knowledge among a class of the community whose avocations prevent them from enjoying the classical education of a college, but they have for thirty years omitted to avail themselves of that patronage and support which it was their duty to procure, and their interest, at least the interest of the Institution, to obtain. Nay, more, they have for thirty years had the management of a public Institution, but they have not, during that whole time, laid before the public, or even before the Visitors, a report of their proceedings, or an account of the state of the Institution. This is a state of things, my Lord, which ought not to be continued. Measures ought to be adopted by you and your colleagues to secure a regular report to the public, of that Institution which is their own, and held for their benefit. You ought to assume that power which is vested in you by the Will of the Founder, and order a yearly report to be published. If we look to Edinburgh, or to London, we see at once the benefit which accrues to scientific institutions when their cause is espoused by those whose situations give them a considerable influence over the minds of others.

It remains with you, my Lord, to remove the glaring inconsistency of a public Institution, whose transactions are unknown to the public. You have merely to speak, and it is done. You, as Convener of the Visitors, can call a meeting of them, at which the Trustees should be ordered to prepare a report of the foundation, progress, present state, and prospects of their charge, and to lay this before the public, who may then know somewhat regarding their own property. I do not, by any means, blame the Trustees for mismanagement of any sort; they are respectable, many of them wealthy, but they *in general* do not take that interest in it which they ought to do. I do not charge them with sins of *commission*, but I do charge them with sins of *omission*, and these greater, in number, than they ought to be. I hope, my Lord, you will use your authority to rescue an Institution worthy of this kingdom, from comparative obscurity, and to raise it to that rank it ought to hold among the monuments of liberality and philanthropy.

I would, in conclusion, my Lord, suggest the propriety of your appointing an annual visitation, at which all may have an opportunity of obtaining redress if they are wronged, and may be encouraged to proceed in their good work.

In a short time I may again trouble your Lordship with a few farther remarks on the same subject; till then, I beg leave to subscribe myself your Lordship's most obedient servant,

A Glasgow Mechanic.

Glasgow, 3d April, 1826.

ON PRINCIPLES IN SCIENCE.

Principle, in science, is a truth admitted without proof, from which other truths are inferred by a chain of reasoning. Principles are of two kinds, *primary* and *general;* and to the last, the name of *axioms* is usually given, on account of their importance and dignity. An axiom, or *general* principle, when the terms in which it is expressed are understood, must be a self-evident truth; but from its very nature it cannot be a *first* truth. Our first truths are all *particular.* A child knows that two *particular* lines, each an inch long, are equal to one another, before he has formed any *general* notions of length and equality. "Things equal to one and the same thing, are equal to one another," is the first of Euclid's axioms; and an axiom it undoubtedly is; but to no man has it been a *first* truth. It is, if we may use the expression, a *genus* or *class* of truths, comprehending under it numberless individuals. Were a person full grown to be introduced into the world, without a single idea in his mind, as we may suppose Adam to have been, he would instantly perceive, upon laying together three pieces of wood, each a foot long, that they were all equal in length; and if he were to cut another to the same length with any one of them, he would find, upon trial that it was of the same length with them all. After a few simple experiments of this kind, he would, by a law of human thought, infer that all things equal in length, or any other dimensions, to any one thing, are, in that dimension, equal to one another.

It was not, therefore, with such weakness as some have imagined, that Hobbes affirmed those propositions, commonly called axioms, not to be primary but secondary principles. A primary principle deserves not the name of an axiom, as it is only a particular truth.—There is not one of Euclid's axioms which has not been the result of induction, though we remember not the time at which the induction was made. That the whole is greater than any of its parts, is a general truth which no man of common sense can controvert; but every one discovered that truth by observing that his body was larger than his head, his foot, or his hand; that a mountain is larger than a mole-hill in the middle of it; and that a piece of timber measuring what is called a yard, is longer than any one of the divisions marked upon it, and termed inches.

The particular observations are made through the senses, and treasured up in the memory; and the intellect, by its constitution, compares them together, marks in what they agree and disagree, and thence draws its *axioms* or *general* principles. He, therefore, who should admit the truth of an axiom, and deny the evidence of sense and perception, would act as absurdly as he who accepts payment in a bank bill, and refuses it in the individual pieces of gold or silver which that bill represents. General axioms are of infinite use in the pursuits of science; but it is not because they create new truths: they only shorten the process in the discovery of such as might be found with labour, through the medium of particular propositions.

Principles, in physics, are often confounded with elements.

ON ARITHMETIC.

1. In pure mathematics, quantities are considered in an abstract manner, and only in so far as they are susceptible of augmentation or diminution. They comprehend arithmetic, or the art of computing; geometry, or the science of extension; and algebra, or the science of magnitude in general.

2. The origin of arithmetic is of the highest antiquity. Nothing, indeed, being more clear and familiar than the idea of *number*; the first men must have counted their fingers and their cattle, their days and their trees, &c.; and it is plain that the formation of societies, and the possession of property, suppose the necessity of calculation.

3. The Phenicians, who were the

first and the most skilful merchants in the world, probably extended the limits of natural arithmetic, by inventing signs and compendious processes; and in this sense, they may be regarded as the first arithmeticians. But we may safely treat as fabulous the opinion of those who tell us that Phœnix, the son of Agenor, first wrote on arithmetic in the Phenician.

4. We may observe, by the way, that Egypt claimed the honour of being the cradle of this art, and that, regarding this useful invention of it as beyond the reach of the human intellect, the Egyptians ascribed it to a beneficent Diety. Hermes was accounted by them the inventor of numbers, calculations, and geometry.

5. All the nations of whom we have any knowledge, (except the ancient Chinese, and a people in Thrace, mentioned by Aristotle,) have chosen the same system of numeration, namely, the decuple progression, and represent numbers by the letters of their alphabets. It was probably from comparing the numbers of surrounding objects with the number of fingers, that made 10 be adopted as the radix of common arithmetic. All nations, in writing the names of numbers at full length, or naming them by sounds, use the decimal mode. The Highlanders, the descendants of the ancient Celts, deviate a little from this; they count by *scores;* they count to twenty the same as in English, and have separate names for the first twenty numbers; after that they say one over 20, two over 20, 3 over 20, for 21, 22, and 23; again, for 30, they say 10 over 20, and go on 11 over 20, 12 over 20, 13 over 20, to 19 over 20, then two 20's for 31, 32, 33, 39, and 40. They have no name in one word for 30, 50, 70, or 90. Had they been a commercial people, it is probable they would have contrived an arithmetic somewhat agreeing with their mode of enunciation. In that case, their multiplication table must have gone the length of 20 times 20; which is an advantage, even with our arithmetic, to those who can learn such a table, as it makes them quicker at common multiplication. The French appear to have had the same mode of naming numbers as the Celts, but they gradually improved it; thus, for 70 they say soixante and dix; for 90 they say quatre-vignt-dix, the same as the Highland mode. From this and other circumstances, analogies of language, antiquarians suppose them to have once belonged to the same family. The different periods of tens were distinguished either by accents attached to the numeral letters, as among the Greeks, or by different combinations of the numeral letters. Those methods became very complicated, and, therefore, very inconvenient, when the numbers were considerable. Hence the processes they followed in arithmetic have been totally forgotten since the present preferable method has been discovered. The ancient Chinese used a kind of binary arithmetic, *i. e.* they counted by two's; thus, 3 they called 2 and 1; 4 they called two 2's; 5, two 2's and 1; 6, two 2's and 2; 7, two 2's, 2, and 1; 8, twice two 2's, &c.—they had an arithmetic according to this plan. Again, those people Aristotle speaks of counted by fours; thus, 11 they called two 4's and 3; and 45 twice four fours, 3 fours and 1. If this nation had an arithmetic, it would be more convenient than the Chinese, but not so much as ours.

6. The ingenious system of numeration which forms the basis of our modern arithmetic, was long familiar to the Arabians, before it penetrated into our quarter of the world; but the honour of the original invention appears to belong to the Indians; for Alsephadi, an Arabian author, says, that the Indians boasted of three things, namely, the book Golaila ve Damma (a kind of fables), the method of calculation, and the game of chess. And Abenragel, an Arabian author of the 13th century, expressly ascribes this scheme of arithmetic to the Indian philosophers.

7. Pythagoras, who was born at Samos, about 589 years before the Christian era, improving by the instruction of Pherecides, devoted himself wholly to philosophy. After the death of his preceptor, he travelled in Egypt, where he conversed with the priests, and was *initiated* into their mysteries. He went as far as the banks of the Ganges. On his return, finding his country groaning under tyranny, he chose a voluntary exile, and carried his learning into Italy. There he established his celebrated school, in which every kind of knowledge which could contribute to improve the understanding and the heart was zealously cultivated. In a short time, Pythagoras

was attended by four or five hundred pupils. Before he admitted them to that rank, he subjected them to a noviciate of silence, in which those whom he thought prone to speak, remained at least five years. His reputation for wisdom rendered him the legislator of that country; and some of his scholars became chiefs of the flourishing states that composed it. He died about 497 years before the Christian era, and left a sect behind him, sometimes called the Italian, and sometimes the Pythagorean. Some of his followers employed nine particular characters in their calculations, while others used the letters of the alphabet, which were the ordinary signs; and it appears certain, that a mode of notation resembling ours was known in the school of Pythagoras. But it is more natural to suppose that Pythagoras learned that invention from the Indians, than that the Greeks had invented it.

8. It is said that this philosopher carried the combinations of numbers very far, and that he attached mysterious properties to some of these combinations. But this is conjectural; for all that he could have written on the subject of numbers is lost, and time hath only respected his multiplication table.

9. In whatever manner the arithmetic we now use, which originated in India, became known to the Arabians, it is to this last people that we immediately owe that art; and it was not till the year 960 or 970 that it was transmitted to the western Christians, by the famous Gerbert, whose merit and wisdom afterwards elevated him to the Papal chair, under the name of Silvester II. He was the son of indigent parents in Auvergne, and was educated in a monastery. Scarcely had he acquired the first principles of the sciences, when he left a country then immersed in ignorance, and travelled into Spain, where he remained several years. He made such progress in the mathematics that it is said he soon excelled his instructors. On his return to France, he taught the sciences which he had learned from the Arabians, particularly arithmetic. Gerbert having become Pope, died in the year 1003.

10. The form of our present arithmetical characters has undergone some change. The figures used by Alsephadi and Bœtius, 1300 years ago, were almost all different from ours. Those of Sacra Bosca and Roger Bacon, in the 13th century, *i. e.* about 600 years ago, had a great resemblance to those used at the present day, the form of which they have gradually assumed. John of Holy Wood, or Holy Oak, *i. e.* de Sacro Bosco, was born in Britain, but in what part is uncertain, nor is it material. He studied at Oxford, next at Paris, where he acquired great reputation for his mathematical talents. He composed a treatise in technical verses on the Arabian arithmetic, and died at Paris in the year 1256. Roger Bacon, an English friar, made such progress about the same time in the mathematical sciences, that his contemporaries surnamed him the Admirable Doctor. He actually made burning mirrors, and proposed ideas which paved the way for the discovery of spectacles, telescopes, and microscopes. Some consider him as the inventor of gunpowder. He died at Oxford, 1294.

11. The Arabians enriched arithmetic with some useful rules, such as those of false position, single and double, of which they were undoubtedly the authors.

12. Decimals were introduced into mathematical calculations by Regiomontanus, about 1460, *i. e.* about 350 years ago. He simplified the arrangement of fractions, and completed our system of numeration. After this the discovery of logarithms, about 320 years ago, carried arithmetic perhaps to the utmost perfection of which it is capable. Napier, the inventor of logarithms, was a Scotch Baron; the family still exists; their title is Lord Napier of Merchiston. Lord Napier, the inventor of logarithms, was born about 1550. At that time learning began to be studied for its own sake, and not merely as the means of rising in the world, as at present; then they pursued it with a keenness and avidity proportioned to their ideas of its great value. But at that time, teachers were few, and students had to depend more on the strength of their own minds, than on any foreign aid that could be derived from books or teachers. This accounts for that originality of sentiment and simplicity of diction, that occurs in almost all the early scientific works. Their authors recollected the difficulties they had met while studying the subjects about which they wrote; they obviated these and aimed only at doing in a homely style. Teachers and

books were not at that time very common, and it was only people above the middling ranks in society that could afford to educate their children. It was the good fortune of Lord Napier to be born in this class. He appears to have been a man of a strong comprehensive mind, that could at once discover in what respects a number of different objects agreed, and in what they disagreed. Hume says, (II. 35, ed. 1775,) "The famous inventor of logarithms, is the person to whom the title of *a great man* is more justly due than to any other whom his country ever produced."

The happy idea of Napier, which performs multiplication by addition; division by subtraction; the formation of powers by multiplication; and the extraction of roots by division, is indeed one of the most useful and ingenious improvements in arithmetic.

MISCELLANIES.

Diving Bell.—A patent has been obtained by Thomas Steele, Esq. A. M. of Magdalen College, Cambridge, for some very important improvements in the construction and apparatus of the diving bell. The improved bell will enable a directing engineer to descend and remain at any depth at which diving bells can be worked, without being subjected to endure the pressure of condensed air, and the working itself is rendered much more safe and effective, by means which Mr. Steele has invented for communicating by conversation with those above, which will supersede the present imperfect and insecure system of signals by strokes of the hammer. He has farther invented, by the application of optical principles, an instrument for the stronger illumination of objects under water, and improved the means of detaching men from the bell.

Ipswich Mechanics' Institution.—The annual meeting of this valuable Institution took place lately, when there was a very respectable attendance. Mr. Clamp was called to the chair. It appears, by a statement then made, that the property of the Institution consists of a pair of Jones's 18 inch globes, three cases of mathematical instruments, &c. and 141 volumes of books. The circulation of books began on the 20th of May; and during the past year, eight lectures have been delivered by members of the Institution. The amount of subscriptions and donations for the year 1825—£126 8s. 5d., and the balance in the hands of the Treasurer—£28 2s. 10d. The books presented to the Institution amount to the sum of £54 and upwards.

Mode of extracting Wax from Honey Combs.—Have on the fire an open vessel of boiling water, and standing by the fire an open vessel of cold water; put the comb, close tied in a canvass bag, into the boiling water, and repeatedly squeeze it down with a stick or large wooden spoon; the wax will come through the bag and swim on the surface of the water; skim it off and put it in the vessel of cold water; by repeatedly squeezing the bag and skimming, every particle of wax will be obtained; when conjealed on the cold water it may be taken off again, melted, and cast into moulds of any convenient shape for sale.

Cementing Amber.—Two pieces of amber may be cemented together by wetting with solution of caustic potash, and pressing the parts together with assistance of heat.

Lewes Mechanics' Institution.—Mr. J. Mantell lately delivered to the members of the Lewes Mechanics' Institution a lecture on Chemistry, at the Public Temple. The interest created on this evening was demonstrated by the numbers that attended, not only of the members, but of many ladies and gentlemen of the town and neighbourhood, who were anxious to witness the well-known talent of the lecturer. The experiments were pleasing and diversified, and added much to the spirit of the lecture; nor did he, among the number made this evening, fail in a single instance, which circumstance added greatly to the effect produced. Many names were added to the list of members.

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A Committee of Civil Engineers and Practical Mechanics.

> "Unerring nature, still divinely bright;
> One clear, unchanged, and universal light;
> Life, force, and beauty, must to all impart
> At once the source, and end, and test of every art."—*Pope.*

No. CXXI. *Saturday, 15th April,* 1826. Price 3*d.*

MR. DANIELL'S HYGROMETER; NIMMO'S NEW INVENTED GAS BURNER, &c.

Fig. 4.

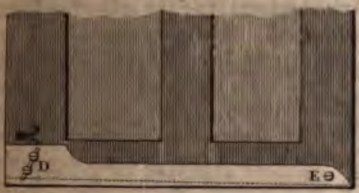
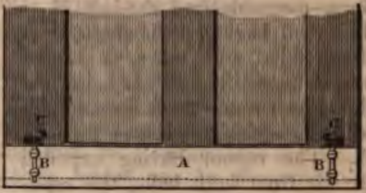


Fig. 3.



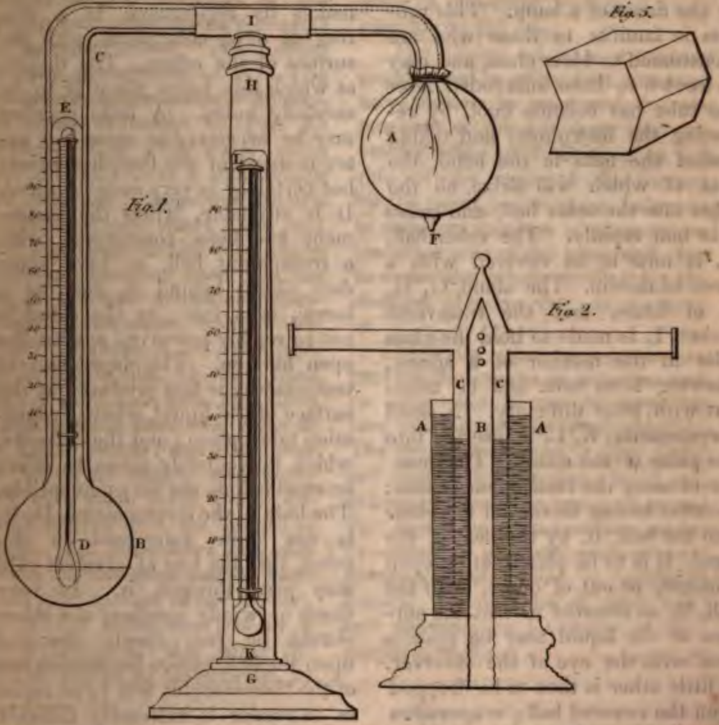


Fig. 5.

Fig. 1.

Fig. 2.

—Swan Sc.—

MR. DANIELL'S HYGROMETER.

Fig. 1 of the plate represents the hygrometer invented by this gentleman. A and B are two thin glass balls of an inch and a quarter diameter, connected together by a tube, having a bore about an eighth of an inch. The tube is bent at right angles, over the two balls, and the arm, B, C, contains a small thermometer, D, E, whose bulb, which should be of a lengthened form, descends into the ball, B.—This ball having been about two-thirds filled with ether, is heated over a lamp till the fluid boils, and the vapour issues from the capillary tube, F, which terminates the ball, A. The vapour having expelled the air from both balls, the capillary tube, F, is hermetrically closed by the flame of a lamp. This process is familiar to those who are accustomed to blow glass, and may be known to have succeeded after the tube has become cool, by reversing the instrument and taking one of the balls in the hand, the heat of which will drive all the ether into the other ball, and cause it to boil rapidly. The other ball, A, is now to be covered with a piece of muslin. The stand, G, H, is of brass, and the transverse socket, I, is made to hold the glass tube in the manner of a spring, allowing it to turn and be taken out with little difficulty. A small thermometer, K, L, is inserted into the pillar of the stand. The manner of using the instrument is this:—After having driven all the ether into the ball, B, by the heat of the hand, it is to be placed at an open window, or out of doors, with the ball, B, so situated as that the surface of the liquid may be upon a level with the eye of the observer. A little ether is then to be dropped upon the covered ball; evaporation immediately takes place, which, producing cold upon the ball, A, causes a rapid and continuous condensation of the ethereal vapour in the interior of the instrument. The consequent evaporation from the included ether, produces a depression of temperature in the ball, B, the degree of which is measured by the thermometer, D, E. This action is almost instantaneous, and the thermometer begins to fall in two seconds after the ether has been dropped. A depression of 30 or 40 degrees is easily produced, and I have seen the ether boil, and the thermometer driven down below 0° of Fahrenheit's scale. The artificial cold, thus produced, causes a condensation of the atmospheric vapour upon the ball, B, which first makes its appearance in a thin ring of dew, coincident with the surface of the ether. The degree at which this takes place is to be carefully noted. A little practice may be necessary to seize the exact moment of the first deposition; but certainty is very soon acquired. It is advisable, when the instrument has been constructed with a transparent ball, to have some dark object behind it, such as a house, or a tree; as the cloud is not so readily perceived against the open horizon. The depression of temperature is first produced at the surface of the liquid, where evaporation takes place; and the currents, which immediately ensue to effect an equilibrium, are very perceptible. The bulb of the thermometer, D, E, is not quite immersed in the ether, that the line of greatest cold may pass through it. In very damp or windy weather, the ether should be very slowly dropped upon the ball, otherwise the descent of the thermometer will be so rapid as to render it extremely difficult to be certain of the degree. In dry weather, on the contrary, the ball requires to be well wetted more than once, to produce the requisite degree of cold. If at any time there should be reason to suspect the accuracy of an observation, it may easily be corrected by observing the temperature at which the dew upon the glass again disappears: the mean of the two observations, (whose errors, if any, will lie in contrary directions,) will give the true result. It is obvious that care should be taken not to permit the breath to affect the glass. With these precautions, the observation is simple, expeditious, easy, and certain.

ACCOUNT OF A NEWLY INVENTED ROTATORY GAS BURNER.

By Mr. James Nimmo, Edinburgh.

This burner is no less remarkable for the unexpected effect which it exhibits, than for the real simplicity of its construction. Its peculiarity is, that it has an incessant rotatory motion, which, when combined with a tasteful variation of the burning jets, produces an agreeable and beautiful effect. The following is a description of it:—The revolving burner consists of an outside case or tube, A, (fig. 2,) which is filled with water three parts full; and B is a tube which rises from the bottom and through the centre of the water case, and which is perforated with holes above the top of the water case. In the tube, B, is a steel centre, terminating with a fine point, upon which the inverted tube, C, C, revolves. This inverted tube, C, seats itself in the water, and does not allow the gas emitted from the holes in tube, B, to escape; and it has four arms of equal length, and finely bored with small holes at the extremity of each arm, for the gas to burn at. All these holes are, and must be at the same side of each arm, to give motion to the burner; some of the holes are put in a vertical direction, and some inclined at angles to those holes in the sides. This part of the burner is susceptible of great variety of contrivances, and may be carried into multiform shapes and figures, which, added to the perpetually revolving motion of the whole, gives a beautiful brilliancy, very pleasing to the eye.

The theory of it is extremely simple, and is only, that the rotatory motion is produced by the pressure of the gas from the gasometer being so diminished on one side of the arms of the burner, by the small emission gas holes, as to cause an increase of pressure on the other side of the tube, and thus to make the whole revolve by the smallest pressure the gas can burn at.

The water joint is necessary to prevent the escape of the gas, and to allow the burner to have an easy motion on the steel point.—The revolving burner is very plain and simple in its action; but I am convinced, from the many attempts that have been unsuccessfully made by others to discover such a contrivance, that, were it publicly known, it would be of great use and convenience for many of the purposes of life.

MODE OF EXCLUDING THE ADMISSION OF AIR UNDER PARLOUR OR OTHER DOORS.

Fig. 3 of the plate represents the method of excluding the current of air, under a door whose bottom is perfectly level, as represented by the dotted line. A is a flat piece of brass, iron, deal, mahogany, or any other material suitable for the purpose, which should be rounded on the bottom edge, to allow of its passing easily over the surface of the floor or carpet, having two grooves or apertures, B, B, cut at the ends, and fastened on by screws, but not so tight as to prevent its rising and falling. C, C are two springs, such as are generally used in the interior of door locks, and placed just above each end, in order to insure the slide returning to its place when the door is shut.

Fig. 4 represents the method of exclusion from under a door whose bottom is not level, as also pointed out by the dotted line: the only material difference in the formation of this slide is, that the groove, D, must be a little curved, and none at the end, E, which is to be merely screwed on; one spring only will be required to this side.

If made of deal or any common material, they may be covered with green baize or leather.

NEW PITCHED PAVEMENT.

A mode of pitching pavement is proposed, founded, as the inventor states, upon the reciprocal bearing and support of the stones. The pavement is formed of granite, or other hard paving stones, of the ordinary size, and each stone is laid or ranged in such a manner, with reference to the contiguous stones, as that neither can be displaced the eighth part of an inch by any pressure or percussion, however great, in the ordinary use of the streets. The stones are not wedges or cubes, but formed as in fig. 5; each contains a protruding or salient angle on the one side, and an indented or receding angle on the opposite side, the receding angle being formed to receive the salient one. In a prospectus put forth, the mode of pitching such a pavement, and raising a stone when required, is depicted and described. The inventor states that its advantages will consist in its level symmetry and uniformity, its cleanliness, its strength and solidity, derived by each part from the whole superficies, facility when laying down and raising, and probable durability. The expense of thus cutting or dressing the stones is not mentioned. It is called the biangular pavement.

ON THE DIFFERENCE IN THE LENGTH OF THE HUMAN FINGERS.

By Thomas M'Keever, M. D.

Notwithstanding the minute attention that has been paid to the structure of the human hand, there is still one point, with regard to this part of our frame, which requires elucidation; and of which, indeed, I am not aware that any explanation, of a satisfactory nature, has been offered—namely, why the several fingers should differ so materially in their respective lengths? Would they not have been just as capable of accomplishing the same variety of purposes, were they all constructed, in this respect, after a similar manner?

The following suggestion is offered, more with the view of inviting discussion, than as a completely satisfactory solution of this difficulty. When we inspect the hand, in its extended condition, the whole may be considered as of a triangular form, the base being placed at the carpus or wrist, while the apex is formed by the extremities of the fingers. On the fore part of the base, or palm, as it is termed, we observe two eminences, with an intermediate depression; one placed externally, or towards the radial side, forming what is called the ball of the thumb, and consisting of a variety of small muscles, which it would be here superfluous to enumerate, serving to flex, to abduct, and approximate to the other fingers, this member: the internal, or lesser eminence, is formed of corresponding muscles for the little finger; while the central depression serves for the transmission of the great mass of flexor tendons, in their passage forwards to the several phalanges. Now, when we close the hand, as in the act of prehension, we find that the extremities of the several fingers adapt themselves, with singular precision, to the irregular surface here described; the index and middle fingers resting on the eminence formed by the muscles of the thumb; the ring finger wedges itself in the central depression, while the little finger is accurately sustained by the lesser projection. Thus an equable support is furnished to the four lesser fingers, and the hand acquires a degree of steadiness, and an extent of power, which it could not well have attained by any other arrangements.

With regard to the thumb, to which Albinus has given the appropriate appellation of a second hand, "Manus parva majori adjutrix,"[*] it is merely necessary to observe, that, from its great size and strength, it is admirably fitted for counteracting the fingers, when brought in opposition to them, as in grasping a spherical body. It is obvious, that, if it were formed equally slender with the other fingers, having to act with the force of 1=4, its power as an opponent must have been materially lessened. The presence of the thumb also enables us to use the hand as a kind of forceps, hence those animals, in whom this member is absent, as the squirrel, rat, oppossum, &c. require the concurrence of both hands, in order to hold any moveable object.[†]

I cannot conclude this short paper, without briefly adverting to the close analogy that is found to prevail between the structure of the human hand and corresponding parts in the lower animals. Thus, the fins of the whale have nearly the same number of bones, and are of a similar form with those organs, although the two parts in the living animal are so exceedingly unlike.[‡] In the turtle there is even the resemblance of a thumb: the bat possesses five fingers, the metacarpal bones, and the phalanges of the four which succeed the thumb, being excessively elongated, so as to allow an extensive surface for the attachment of the membrane that serves this animal as a wing.

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[*] De Scelato, p. 465.

[†] Only man, apes, and lemurs, have the thumb separate, and capable of being opposed to the other fingers.—See Cuvier's Comp. Anat. vol. i.

[‡] See Sir E. Home's Lect. on Comp. Anat. vol. i.

The bones of the fins in the seal are also of an analogous structure. Lastly, the fore feet of the lion has the same bones, and the same number of claws, as the human fingers.

There also appears to exist a regular gradation in the number of the fingers. Thus in MAN, *simiæ*, and *lemurs*, we have five, the thumb being separate :* the elephant,* kangaroo, bear, lizard, and dog have also five, but no separate thumb : the hippopotamus and hog have four; the tapir and rhinoceros three; the deer, cow, camel, and cameleopard two; while the solopeda, as the horse and ass, possess but one perfect finger.

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* In the simiæ, the thumb is small, short, and weak, and the other fingers elongated and slender. They cannot move them separately, having no proper flexor or extensor muscles.—See Cuvier's Comp. Anat. vol. ii.

* The elephant has five perfect toes, but the whole five are almost entirely concealed under the thick skin which covers the foot. —Cuvier's Comp. Anat. vol. ii.

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MODE FOLLOWED BY THE SERPENT EATER, (FALCO SERPENTARIUS,) FOR DESTROYING SERPENTS.*

BEFORE concluding (Mr. Smith remarks) I may mention a curious circumstance, of which I was informed a few days ago, by a gentleman upon whose veracity I can place the utmost dependence, and which is a fact, in as far as I know, not generally known. It relates to the mode which the Falco Serpentarius of Linnæus follows in destroying snakes. Some time ago, when the said gentleman was riding out, he observed a bird of the above-named species, while on the wing, make two or three circles, at a little distance from the spot on which he then was, and after that suddenly descend to the ground. On observing the bird, he found it engaged in examining and watching some object near the spot where it stood; which it continued to do for some minutes. After that, it moved with considerable apparent caution, to a little distance from the spot where it had alighted, and then extended one of its wings, which it kept in a continual motion. Soon after this artifice, the gentleman remarked a large snake raise its head from the ground, which seemed to be what the bird was longing for, as, the moment that took place, he instantly struck a blow with the extremity of the wing, by which he laid his prey flat on the ground. The bird, however, did not yet appear confident of victory, but kept eying his enemy for a few seconds, when he found him again in action, a circumstance that led exactly to a repetition of the means already detailed. The result of the second blow appeared, however, to inspire more confidence; for almost the moment it was inflicted, the bird marched up to the snake, and commenced kicking it with its feet; after which, he seized it with his bill, and rose almost perpendicularly to a very considerable height, when he let go the reptile, which fell with such violence on the ground, as seemingly to satisfy him that he might now indulge himself with the well-earned meal in perfect safety.

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* From a letter from Mr. T. Smith, Museum, Cape Town, to Professor Jamieson.

OF PHYSICAL PRINCIPLES.

The evidence of the external senses is obviously the *primary principle* from which all physical knowledge is derived.

But whereas *nature* begins with *causes*, which, after a variety of changes, produce *effects*, the senses perceive the *effects*, and from them, through the slow and painful road of experiment and observation, ascend to causes.

Man appears, upon the stage of this material system, as upon a visionary theatre, in which he looks only upon the exterior of things, as the eye upon a flower that is full blown, without immediately observing the different stages through which it has passed, and without descending to the seeds and principles from which they spring, and which, upon examination, will be found totally different, both in form and colour. In like manner are the senses, the ultimate criteria of all physical knowledge, liable to be imposed upon and deceived, with regard to the qualities and causes, the powers and operations, of physical bodies.

The senses are therefore to be assisted by observations made with diligence and circumspection; they must also be assisted by different analysis, which divest nature of her external and compounded form, and lay open her internal mechanism and construction; their errors and misconceptions are to be rectified by the result of experiments. By the application of such assistance, the senses are enabled, but not without difficulty, to pass from one appearance to another, and as far as human search can go, to judge of the realities of things.

The information which the senses give us, as Lord Bacon, the great friend and father of philosophy, has observed, is to be examined and corrected by various methods; for though they frequently deceive us, they themselves discover the errors into which they lead.

The senses are subject to a twofold defect; they either desert or deceive us. Many substances elude their cognizance, however perfect and free from impediment. This arises either from the tenacity of the whole object, or the extreme minuteness of its parts; from the distance of its situation, the slowness or swiftness of its motion, its familiarity to the eye, and from many other causes. Even where they fully apprehend their object, they are not to be securely relied upon; for the testimony and information of the senses depend on the analogy and constitution of man, and not on that of the universe.

To obviate the imperfections of sense, philosophers are under the necessity, by much labour and attention, of calling in aid from every quarter, in order to supply deficiencies where the senses fail us; and also to regulate and rectify the senses, when they vary from one another. This is effected, not so much by the use of instruments, as by the help of experiments; for experiment puts the matter upon which it is performed in a new light, when the senses observe whether all its properties remain. Experiment is the best and only method of acquiring a knowledge of nature, especially when ingeniously contrived, and applied with skill to the subject of inquiry.

Philosophers do not therefore rely upon the perception of the senses, immediately applied, as in their proper and common exercise, but bring the matter of judging to this issue; that experiment puts the subject of inquiry in different lights; the senses convey intelligence of these variations to the mind, and it judges whether the subject of inquiry possesses any property, in common, in all those situations.

GLASGOW MECHANICS' INSTITUTION.

SUBJECTS FOR ESSAYS PROPOSED BY MR. DEUCHAR, FOR THE STUDENTS ATTENDING HIS CLASS.

[Continued from page 441, Vol. IV.]

28. Let each of the arms of a lever of the first order be four feet long, it is required how we must arrange the weights, and at what respective distances from the fulcrum we must place them, so that four weights of 2, 4, 6, and 8 parts on the one arm, may balance one weight of 120 parts on the other arm?

29. At the opposite ends of a brass rod which is two feet long, let there be placed two ivory balls, the one weighing 2 oz. and the other 16 oz.; it is required under what part of the brass rod we must put a fulcrum, (such as the back of a knife,) to enable the two balls to balance each other?

30. There are two horses of unequal strengths, the one being able to draw one-third more than the other, and they are to be yoked into the same carriage; it is required how this may be accomplished, so as to bring the full power of both into action, without the weaker horse retarding the stronger, or the stronger one straining the weaker?

31. A bucket holds 192 parts of water, and it is wished to draw it full out of a well by means of a horse, which, to proceed easily and constantly, cannot draw more than 32 parts. How is this to be accomplished?

ON SULPHURETTED HYDROGEN GAS AS TEST FOR ARSENIC.

By Peter M'Callum, Esq. Surgeon in the Hon. East India Company's Service.

[Communicated by Mr. Maclure, Surgeon, Glasgow.]

The accurate and well-conducted experiments of Dr. Christison, related in his paper on the detection of arsenic in mixed fluids, in the Edinburgh Medical and Surgical Journal for 1824, confirm, in the most satisfactory manner, the decided delicacy and superiority of sulphuretted hydrogen as a test of minute traces of arsenic. He has in these experiments, which were made on different animal and vegetable substances, such as broth, soup, tea, coffee, and port wine, in which a small portion of arsenic had been dissolved, shown that this very valuable test is very little, or in no appreciable degree affected by the presence of these various substances, and in this manner has completely established its efficacy and utility as a test. Dr. Christison directs that a *stream* of the gas should be made to pass through the suspected liquid. This certainly is the best mode of applying it, and should always be used in preference to sulphuretted hydrogen water, or any other diluted form of the gas. This can be very easily accomplished in the laboratory of the chemist, where a stream may at all times be commanded from a gasometer or gas-holder; but in the country, where the surgeon not unfrequently is called to investigate cases of suspected poisoning by arsenic, such an expedient is, I may say, altogether impracticable, and where, on that account, he must adopt the use of tests that are indecisive and equivocal, and that lead, it is to be feared, to false, incorrect, and highly dangerous conclusions. This consideration has induced me to propose the following method of procuring and applying sulphuretted hydrogen as a test of arsenic:—

Into a tubulated retort put a mixture of an ounce and a half of fine iron filings, and an ounce of flowers of sulphur. To this mixture a quantity of water sufficient to form it into a thick paste is to be added, and the whole heated to the boiling point. The mass then assumes a black colour, and a pretty copious disengagement of heat takes place; this is the indication that the desired compound, sulphuret of iron, is formed. I may remark that the above proportions are perhaps better adapted, according to the laws of the atomic theory, to combine, than those proposed by Gay Lussac, who directs two parts iron filings, and one of sulphur to be used; or to those of the celebrated Professor Thomson of Glasgow, who uses equal parts of each of the ingredients.

Before I proceed farther, I may describe the apparatus that I would propose for receiving the gas. It consists simply of a bladder, furnished with a stopcock, and a tin or iron tube of small calibre, about three inches in length, proceeding from the mouth of it. Before using it, it is of course to be wetted, and the whole of the common air pressed out of it. When the gas is to be procured, a quantity of sulphuric acid, diluted with three or four times as much water, is to be poured on the black mass in the retort. Sulphuretted hydrogen is then copiously disengaged, and is allowed to escape till the common air is driven out of the retort, which is known by the disagreeable smell of the gas diffusing itself through the apartment. When this is ascertained, the stopper is put in, and the bladder, as described above, is to be inserted into the mouth of the retort, and made air-tight. The gas, which is evolved in great abundance, will pass into the bladder, which is soon filled by it, and, after shutting the stopcock, may be removed, and another, if necessary, substituted. In this manner, a sufficient quantity of gas can be procured to answer the purpose intended. It, however, sometimes happens that a retort cannot be conveniently got in the country, and, when that is the case, I would make the following modification of the above process. The proportions of iron filings, sulphur, and water, above specified, are to be put into a phial of proper size, and heat, as before, cautiously applied. The dilute sulphuric acid is poured on the mixture, and a cork, with an aperture in it, is to be well adapted to the mouth of the phial; and, after the escape of the common air, the bladder, with this difference in its construction, is to be applied. Instead of the stopcock and tube, the barrel of a goose quill is to be inserted into its mouth, and firmly tied; and a piece of twine, formed into a loose knot, is put over its neck, at the extremity of the quill. Thus prepared, it is to be used, by inserting the quill into the phial through the aperture in the cork, and, when filled, the knot is drawn tight, which completely prevents the escape of the gas. It is applied in the following manner. The suspected matter, if solid, as Dr. Christison directs, is boiled briskly for a short time, and the liquor filtered. The filtered liquor is poured into a deep glass, with the addition of a few drops of acetic acid. The stopcock is opened, or, in the other case, the knot is loosened, and a brisk or slow stream of the gas is produced at pleasure, by the pressure of the hands and fingers on the sides of the bladder. If arsenic is present, a beautiful golden yellow precipitate falls to the bottom of the glass. This precipitate is to be collected and dried, put into a glass tube, sealed at one end, and mixed with a little black flux, a compound formed by burning one part of nitre and two of tartar. The bottom of the tube is urged with the blow-pipe, and the arsenic sublimes and lines the inner surface of the tube. It can afterwards be collected and subjected to further experiments; but for the manner of doing this, and for some other particulars, I refer the reader to the paper above alluded to: my object has been, to point out an easy, simple, and eligible method of procuring and applying the test.

ACCOUNT OF THE NATIONAL MILITARY SCHOOL OF THE UNITED STATES OF AMERICA.

[From the London Journal of Science.]

The Military School at West Point is an institution of which the people of the United States are with reason proud. It is also one which promises, at no distant period, to exert a very considerable influence upon the character and habits of the nation.

This Military School is situated in the state of New York, about sixty miles from the city of that name, and on the western bank of the Hudson River. The parade ground comprises a space of several hundred acres, nearly level, elevated about 200 feet above the river, whose banks are precipitous; this plain is inclosed by the river on two sides, while to the west and south it is bounded by steep rocky ridges, forming parts of mountains, that rise to the height of from 1200 to 1500 feet. From the plain, a view presents itself, towards the north-west, almost unrivalled in beauty and extent. The river is first seen, confined between rocky mountains, through two ridges of which it seems as if it had forced its way at some former period, yet still presenting a channel of more than a thousand yards in breadth, navigable in every part for the largest ships; beyond this it spreads into a wide way, and bending towards the east, is lost to the sight; the shore of this bay next appears, studded with populous villages, and rich with cultivation, over which are seen a succession of woody eminences and fertile vales, until the view is bounded by the straight outline of the Shawangeurk ridge, and the more distant, lofty, and picturesque summits of the Kaatskill mountains. In other directions the prospect is less extended, but is still magnificent, presenting occasional glimpses of the river, and a rich amphitheatre of mountains clothed with forests. The artificial objects constantly moving upon the river are hardly less interesting than the natural scenery. They consist of steam boats thickly crowded with passengers, and vessels of every variety, from the occasional Indiaman and Whaler, to the smallest river-craft.

If, as is generally admitted, the

youthful mind receives a character from surrounding objects, such a situation as West Point is admirably suited, in that respect, to the purpose for which it is employed; and it besides possesses the advantages of fine water, pure air, and a most salubrious climate. But, in addition to physical circumstances, there are also mental associations that cannot fail to have a powerful influence. West Point is distinguished, in the annals of the American revolutionary war, as affording a final and insuperable barrier to the favourite plan of the British ministry, which was, by simultaneous movements from Canada and New York, upon the line of the Hudson, to divide the eastern from the southern states. At West Point, Arnold commanded, when his revolt had nearly furnished the means of overthrowing this barrier; and, in the casements of one of its fortresses, the unfortunate André was confined, in the brief and melancholy period that elapsed between his capture and trial. At West Point, too, Kosciusko, not less the champion of American than of Polish liberty, long resided, and his favourite resort is still shown, hanging, like a shelf of verdure from the precipice, midway between the plain and river.

The public buildings are principally situated on the south side of the plain; they consist of a mess-house and hotel for the reception of visitors; the academy, which contains the principal lecture and visitation rooms; and two large barracks for the lodgement of the cadets. On the western side are the houses of the superintendents, professors, and officers of the institution. There is, besides, on the north, close to the bank of the river, a large barrack, for the accommodation of a company of regular troops that is constantly on duty at West Point, and of the musicians and artificers.

The public edifices are plain buildings of ruble stone, without any pretension to architectural embellishment, but solid and substantial; the dwelling houses are chiefly of brick, and are convenient and comfortable; the barrack for the troops is of wood, and although entirely destitute of ornament, has more architectural beauty of form than any other building on the Point.

The establishment consists of two hundred and fifty cadets, entirely supported and educated at the expense of government. In the earlier stages of the school, before its advantages were appreciated, and before the system of education reached the state in which it now is, the number of applicants rarely amounted to more than the vacancies, and no rule was adopted in relation to the choice of candidates. Of late, however, the appointment of cadet has been eagerly sought for, and the principle has been followed of dividing the warrants among the several states, in the ratio of representation, and it is now contemplated to extend this principle, so that each congressional district shall always have a pupil at the academy. The cadets are divided into four classes, one of which graduates annually, and has its place supplied by new warrants. The course, therefore, occupies four years, and is divided and distributed in the following manner: During the first year, the principal attention is directed to mathematical studies, and to the acquisition of the French language. To obviate a difficulty too frequently experienced in other American institutions, where it becomes necessary to suit the course to a medium state of talent and industry, by which it happens that boys of talent are but partially employed, while the dull and careless are left behind, it is adopted as a general rule at West Point, to divide each class into as many sections in each department as will, on the one hand, secure the utmost proficiency, and on the other, prevent any absolute failures, unless they arise from negligence and idleness. The lower class has four sections in mathematics, and five in the French language. The first mathematical section of this class passes through a course that comprises algebra, geometry, analytic, plane, and spherical trigonometry, and descriptive geometry. The studies of the second section are the same as those of the first, but differ a little in extent. In the third section, the same subjects are still studied, except that but a portion of the text-book in descriptive geometry is prescribed; while the fourth section proceeds no farther than algebra and geometry.

The studies in the next class are still chiefly in the same branches, and it is divided in mathematics into three, in French into four sections. The first mathematical section studies surveying, descriptive geometry, conic sections, perspective, analytical geometry, and the calcul différentiel et intégral, in the treatise of Lacroix. The second, surveying, descriptive geometry, conic sections, perspective, analytic geometry, and the calcul in the treatise of Bourhalot. The third, analytic, plane, and spherical geometry, surveying, descriptive geometry, perspective, and fluxions in the American edition of Hutton's Mathematical Course. In this year the cadets commence a course of drawing, which is confined, while they continue in this class, to the human figure.

The third year is devoted to natural philosophy, chemistry, and
the drawing of landscapes and
graphy. The philosophical d
ment has three sections, an
chemical four.

The fourth year's course
prises engineering, miner
geography, history, and ethic
military tactics. The class i
gineering has two sections.

Although military tactic
only taught theoretically durii
last year, a considerable port
time is spent daily in acq
practically, a knowledge o
duties of the soldier. With
view, and for the preservati
discipline, a guard is regular
tailed, centinels posted, d
ments made for police dut
strict inspection held of clo
arms, and equipments, and r
drills in the manœuvres of in
and artillery, performed und
eye of the professor of tactic
has the immediate military com
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commissioned officers are gi
rewards for military merit, a
several appointments of com
in battalion, are held in rotati
the cadets of the highest
The discipline of the lectur
class rooms is also strictly mil
each section has its officer, v
bound to notice, and, if nece
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The professors and teache
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similar ones in other Americ
stitutions, where much mo
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good order, the punishmen
reformation of offenders, th
actual instruction. The m
school, indeed, presents a m
teresting example of strict

and discipline; every duty, whether of the soldier or the student, is performed at its appointed time, without the least confusion, and every hour from réveillé to tatoo, has its appropriate duty and employment.

It is in this respect, that the real and paramount excellence of the military academy consists; every cadet, whatever may be his proficiency as a student, insensibly acquires habits of regular application to business, of courteous and gentlemanly manners with equals, of submission to superiors, and of firm, yet condescending conduct to those in subordinate situations, that are of immense value to him throughout life; and no instance has ever occurred where a graduate has not fully realized the expectations that have been formed of him, when called to active service.

Such being the obvious and apparent results of an education at West Point, it may not be uninteresting to inquire into the means by which they are produced.

In addition to the division of the classes into sections, each section is arranged in individual rank, according to the respective merit in study of the individuals that compose it; those who manifest the necessary improvement are advanced into higher sections; those who fall off, degraded to lower; and the incorrigibly idle, dismissed the institution. In addition to this arrangement in the several departments of study, general merit-rolls of each class are formed in which military acquirements and correctness of deportment have their full weight. These rolls are made up at the general examinations, which take place twice a-year—once in the presence of the assembled instructors only, and once publicly, and before a board of visitors, named by the secretary of war for the purpose. These rolls are not only submitted to the war department and printed, but the names of the four most distinguished cadets in each class are annually published in the army list of the United States. Every cadet who passes through the four years course, and receives his diploma, is entitled to a commission in the army, whether there be vacancies or not; and among the vacancies that may have occurred within the year, the most distinguished cadets have the right of choice, in the order of the general roll of merit.

For breaches of good order and discipline, for inattention to the duties of the soldier, the punishments are, extra drills, additional police duties in the barracks or externally, arrest in their rooms, confinement in the guard-house, in the light or dark prison, and finally, dismissal. The punishment of dismissal involves such consequences, as, in most cases, to insure entire submission; it not only deprives the delinquent of an education at the public expense, but is a bar almost insuperable to employment in the service of the government; for although there is no specific law on the subject, it has become matter of understanding among the several departments, that no disgraced cadet shall, on any account, receive an appointment in the gift of the executive of the United States.

It is difficult to conceive any improvement upon this part of the system. It owes its perfection of principle and practice to the unwearied efforts of the present superintendent, Lieut. Col. Thayer, of the United States corps of engineers. Its success in application is also due, in a great measure, to the firmness, impartiality, and temper with which he has discharged his difficult and important task; but in this respect he has received no small aid from the present accomplished instructor in military tactics, Major North.

(*To be continued.*)

THE POOR MAN'S BAROMETER.

Both the *convolvolus* and the *pimpernel* (anagallis) fold up their leaves on the approach of wet weather. The latter is called the poor man's weather-glass. In the same manner the different species of *trefoil* contract their leaves at the approach of a storm, and they have been named the husbandman's barometer. *Chickweed* is another plant, which answers the same purpose. When the flower expands boldly and fully, no rain will happen for four hours or upwards: if it continues in that open state, no rain will disturb the summer's day. When it half conceals its miniature flower, the day is generally showery; but if it entirely shuts up or veils the white flower with its green mantle, let the traveller put on his great coat, and the ploughman, with his beasts of draught, expect rest from their labour. But these, and a multitude more of such observations as these, are of no use, and can give but little pleasure to the inhabitants of crowded and populous cities. Perhaps, indeed, after the reviving effects of pure air and a clear sky, the dwellers in thronged and close pent up streets suffer no greater privation than the want of every opportunity of observing the numerous little facts which are connected with the habitudes of vegetables, insects, and animals.

DUBLIN MECHANICS' INSTITUTION.

Wednesday, a public meeting of the friends of the Dublin Mechanics' Institution was held in the lecture room of the Dublin Institution.

The Right Hon. the Lord Mayor in the Chair.

Rev. Mr. Groves (secretary) read a report, drawn up by the committee, setting forth in detail the objects and progress of the Dublin Mechanics' Institution. The Reverend Gentleman stated, that it had been determined last September, to call a public meeting on as early a day in the ensuing year as possible. A committee of nine was then appointed, who drew up the report and the resolutions, which should be submitted to the meeting. That committee waited on the Lord Mayor to request him to patronize the Institution by his presence. With this request his Lordship, in the kindest manner, complied. The Reverend Gentleman read the report, which stated, that the Dublin Mechanics' Institution was now one year in existence. The report then adverted to Scotland, where Mechanics' Institutions were first originated; a country which, containing only two millions and a half of inhabitants, had four Universities, and in every parish a school, where English, Latin, and the rudiments of the sciences, were taught. It was in the Andersonian school, so named after its founder, that lectures were first delivered to the mechanics, by the celebrated Dr. Birkbeck. These lectures first suggested the idea of Mechanics' Institutions; and by an extract from a letter written to one of the members of the committee, it appears that there were in Glasgow two Institutions, one containing seven hundred members, and the other four hundred. In London, such was the ardour with which the idea of a Mechanics' Institution was received, that Sir Francis Burdett gave a donation of £1000; several individuals also presented donations to the amount of one hundred guineas each, and at this moment they have a lecture room capable of accommodating one thousand persons. This splendid liberality which had been exhibited in London, Glasgow, and other cities and towns, was not imitated by the gentry and citizens of Dublin; the consequence was, that the Institution had to labour under many difficulties for want of means. Even from the first, it had been discouraged, many considering it was not adapted to the peculiar circumstances of this country. To the operatives themselves the credit is chiefly due for the partial success of the undertaking. When they learned that there was a chance of having a Mechanics' Institution, many of them came forward to co-operate with those gentlemen who had originated the plan here. The collections and subscriptions amounted to £450, of which £150 was the donation of different individuals to the amount of £5, and upwards. (The secretary here read the names of the contributors, which were received with loud applause by the meeting.) The lecture room of the Dublin Institution was hired, when the Rev. Dionysius Lardner delivered a course of lectures. These lectures began in May, and did not end until September; and it was a melancholy fact that they were obliged to hire the apparatus for these lectures, at a price which would have nearly enabled them to purchase a new set of apparatus for the constant use of the Institution.—Mr. William Ottley, one of the candidates for the Chair of Chemistry at the Dublin Society, offered to deliver a course of lectures on Chemistry gratis, provided the proper apparatus was provided for him.—(Applause.)—These were procured by the assistance of different individuals, and the expense to the Institution did not amount to more than £13. So slow and insufficient had been the collection of the books, that it was not thought proper to open the library until the present year, as but few useful books were presented to them. To enable the Institution to have a proper collection, would at least cost the Institution £150. To have a proper library and lecture room would, at the lowest calculation, cost them £200; and for the fitting up proper apparatus, £200. To cover these two latter expenses, the committee proposed that they should have one hundred life members, who should subscribe £5 each. This sum would enable the Mechanics' Institution to proceed. and put it within their power to confer on the mechanics those advantages and that instruction which they seemed so anxious to receive. The conduct of the operatives had been most unexceptionable; there never was exhibited by them the slightest symptom of inebriety or indecorum; nor had they even evinced any undue familiarity with those who had consorted with them for the purpose of instructing and advising them.—(Applause.)—The report concluded by mentioning, in high terms of praise, the readiness and alacrity with which the Lord Mayor had consented to take the chair at that meeting.—(Applause.)

After this, various resolutions were passed, from which there seems every reason to hope that the Institution will soon be out of all danger of falling to the ground—although hitherto there seems to have been much reason for fearing this.

The following extract from one of the speeches made on the occasion, shows very strongly the great necessity for a Mechanics' Institution in Dublin; and it is to be hoped that a few years hence, it will be impossible for any one thus to speak of the mechanics of any portion of the British empire.

Mr. Peter Brophy said, he could not avoid saying a few words before proposing the resolution. Though he had the honour of being a subscriber to that Institution, he should say, that until that day he did not know half its merits. He, as an humble advocate of that Institution, had applied to a friend of his, who had obtained more than one patent for his inventions. He stated to that gentleman his surprise that he, of all men, should not have become a member of the Dublin Mechanics' Institution. That gentleman's answer to him was, that he was disgusted with the mechanics of Dublin; that he was obliged to send all his models to England to have them executed; that he found it most difficult to make them understand or comprehend the most common ideas; and even when he had effected that, there were many difficulties and obstacles thrown in his way; that what might be perfected in six weeks, was not done in six months; that when the mechanics had procured sufficient for idling, they went about idling, instead of attending to their work.

USEFUL RECEIPTS.

To make Ginger Beer Powders.—Take 5 scruples of loaf sugar, powdered, 5 grains ginger, 25 grains subcarbonate of soda; mix and fold in a blue paper. Then take 30 grains tartaric acid, powdered. Fold this in white paper for distinction. These are sufficient to make half a pint.

To make Spruce Beer.—Put four gallons of boiling water into a tub or cask with four gallons of cold water, by which you will get the proper degree of heat; then add eight pounds of treacle, and two or three table spoonsful of the essence of spruce: stir these thoroughly well together, and add a quarter of a pint of good yeast. It is now to be kept in a temperate situation till the fermentation is somewhat abated, (which will be in about 48 hours,) and then bottled off, when in two days it will be fit for use.

To clean Boot Tops.—The following genuine receipt may be fully relied on for actually producing this desirable effect, as well as for readily taking out grease, ink spots, and the stains occasioned by the juice of fruit, red port wine, &c. from all leather or parchment. Mix in a phial 1 drachm oxymuriate of potash, with 2 ounces of distilled water, and when the salt is dissolved, add 2 ounces of muriatic acid. Then, shaking well together in another phial, 3 ounces of rectified spirit of wine, and half an ounce of essential oil of lemon; unite the contents of the two phials, and keep the liquid thus prepared closely corked for use. This chemical liquid should be applied with a clean sponge, and dried in a gentle heat, the boot tops may be polished with a proper brush, so as to appear like new leather.

A very strong Cement for broken China.—Take equal parts of isinglass, mastic, and turpentine, beat them together in a stone mortar till they are well united, and then join the pieces well together. If the composition is not of a proper consistency, add more turpentine.

Chinese Method of Mending China.—Boil a piece of white flint glass in river water for five or six minutes; beat it to a fine powder, and grind it well with the white of an egg, and it joins the china without rivetting, so that no hurt can break it again in the same place. Observe, the composition must be ground extremely fine on a painter's slab.

Cement for Mending China, Glass, &c.—Take a piece of Cheshire or Gloucestershire cheese, boil it in three or four different waters, till it forms a soft elastic mass, freed from the whey, and the extraneous ingredients. After having expressed all the water from this mass, and while yet warm, it must be gradually rubbed upon a piece of marble, such as is used by colourmen, and as much unslacked, or quick lime, in powder, must be added, as will be absorbed by the cheese without making it too hard. This compound forms the strongest possible cement, if allowed to dry slowly; it is able to withstand fire as well as water.

Furniture Varnish.—White wax, 8 ounces; oil of turpentine, 1 pint.

Picture Varnish.—Mastich, 12 ounces; Venice turpentine, 2½ ounces; gum camphor, 30 grains; pounded glass, 4 ounces; oil of turpentine, 3 pints and a half; pour off the clear liquor:—for oil paintings.

Method of Marbling.—Pour hard clear water into any vessel large enough for marbling; throw on large spots of Prussian blue till the surface of the water is nearly covered; then throw on king's yellow in small spots, which will immediately run into streaks or veins in all directions. Press the article to be marbled lightly on the surface of the colours, which will make a beautiful marble, and burnish well. The ground colour, or that which is thrown on first, must always be ground with *brown* soap, and that for the veins with *white* soap.

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> "Our needful knowledge, like our needful food,
> Unhedged, lies open in life's common field,
> And bids all welcome to the vital feast."—*Young.*

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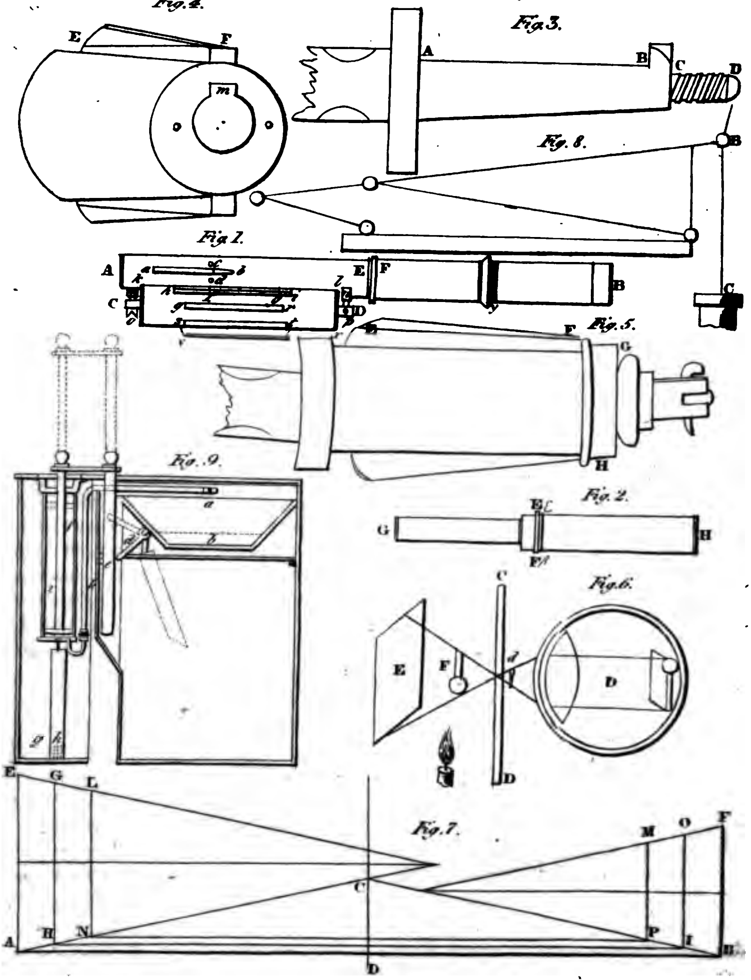
MR. ADAM'S INVERTING SEXTANT TELESCOPE; REV. MR. LARDNER'S METHOD OF SECURING CARRIAGE WHEELS; JORDAN'S IMPROVED WATER-CLOSET, &c. &c.



DESCRIPTION OF AN INVERTING SEXTANT TELESCOPE, WITH NAUTICAL EYE-TUBE, FOR TAKING ALTITUDES AT SEA WHEN THE HORIZON IS INVISIBLE.

Invented by Mr. MATTHEW ADAM, A. M., Rector of the Academy at Inverness.*

[From the Edinburgh Journal of Science.]

THIS telescope, represented by A, B, (fig. 1,) consists of three parts, *viz.* 1st, the eye-tube, A, E, to the lower side of which a spirit-level, *k*, *x*, is attached by the screws, *o*, *p*, passing through the extremities, C and D, of the frame of the level tube; 2d, the object tube, F, B, which is attached to the sextant by the screw at *y*; and 3d, the middle or connecting tube, E, F, represented separately by G, H, (fig. 2,) of which the part, E, H, enters the object tube at F, and the part, E, G, is screwed into the eye-tube at E, by means of the screw, E, K, and thus brings the small glass, G, into its proper place at *b*, near the field of the telescope. The reduced diameter of the part, G, K, permits the upper side, *k*, *l*, of the lever tube to enter 1–8th of an inch within the lower side of the eye-tube, and thus brings the bubble, seen directly through the eye-glass at A, as near as possible to the field of the telescope. In the centre of the field, two cross hairs of silk intersect each other at right angles, the one horizontal, and the other vertical; and the point of their intersection is adjusted exactly into the line of vision through the telescope, by means of the screw nails, *c*, *d*, acting on the diaphragm, the edge of which, seen at *e*, is filed quite thin on the farther side, for the purpose of more easily admitting the direct light of a lamp through the aperture, *a*, *b*, to illuminate the cross hairs at night. *h i*, *q r*, and *s t*, are rectangular apertures in the frame of the level tube, and *t v*, is a reflector placed below *s t*, to illuminate the spirits, and to show more distinctly the position of the bubble. The lines, *f* and *g*, are painted on the level tube at opposite extremities of the bubble, when it is in the middle; and, as the level is applied so that the line, *f*, is placed at the focal distance of the eye-glass, the eye end of the bubble can be distinctly seen at *f*, and at 1–3d of an inch on either side of it. When, therefore, *k*, *l*, the upper side of the level tube, is adjusted parallel to A, B, the line of vision through the telescope, if the eye end of the bubble be observed, and kept at *f*, the line of vision, A, B, must then be truly horizontal, or parallel to the horizon. In order to take the altitudes at sea by a quadrant or sextant, furnished with this telescope and level, which may be made capable of distinguishing 10′, the observer should hold the sextant, as usual, in a vertical plane, passing through the celestial object whose altitude is required, the telescope being horizontal, and then bring the reflected image of the sun, moon, or star, into the field by the motion of the index on the limb of the instrument, which, after some experience, he will generally be able to do upon the first or second trial.

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* This eye-tube was executed under Mr. Adam's Inspection in July 1825, by Mr. Robinson, Mathematical Instrument Maker, at 38, Devonshire-Street, Portland Place, London. The dimensions of the telescope and level are reduced one-half in the annexed diagrams.

When the celestial object is thus brought into the field, and the near end of the bubble seen at *f* in the level tube, the observer should clamp the index on the limb, and, by means of the tangent screw, while the near end of the bubble is kept at *f*, bring the lower limb of the observed object to touch the horizontal hair passing through the centre of the field; the required altitude of the lower limb of that object, affected only by refraction, will then be found, as usual, on the limb of the sextant.

To enable the observer to keep the eye end of the bubble at *f* till the required contact is observed, a light mahogany rod, about 2½ feet in length, attached to the sextant parallel to the telescope, is pressed against some fixed object on deck, which enables him gently to elevate or depress the telescope till the bubble is brought into the required position, and kept there as long as may be necessary. For this purpose, an iron staunchion, about six feet in length, should be made to screw, when required, into different parts of the deck near midship, with a sliding projection, about two or three inches in length, which may be fixed by a finger-screw at any required height, so as to afford a convenient prop, against which the sextant rod may be pressed by the observer, when taking observations. To show the cross hairs, and the position of the bubble, when taking night observations, a small lamp, made for this purpose, is applied to the right side of the eye-tube by means of a brass rod, fixed to the lamp, which slides in a square socket, attached to the cylinder on the right of the holder of the telescope. The quantity of light thrown upon the bubble and cross hairs, is easily increased or diminished by moving the lamp rod a little forward or backward in the socket. The same lamp, when detached, enables the observer to read off his observations.

The screw, *o*, *m*, acting through the near end, C, of the level frame, gives it its vertical adjustment; and the two screws at *p*, acting horizontally against each other through the farther end, D, give it its lateral adjustment. The accuracy of the vertical adjustment may be examined by comparing meridian altitudes of a celestial object, taken by means of the level, with those taken at, or nearly at the same time, by means of an artificial horizon. At sea, the accuracy of this adjustment may be examined by moving the index backwards, off the limb, as many minutes as are equal to the dip of the horizon, and then observing whether the reflected horizon of the sea is brought up to the horizontal hair in the centre of the field, when the eye end of the bubble is at *f* in the level tube; if not, its distance ± from its equal to the error of the vertical adjustment, which may either be corrected by the screw, or allowed for, like an index error of the sextant.

To examine the lateral adjustment, screw the object tube, F, B, firmly into the sextant holder of the telescope by means of the screw at *y*, or fix it steadily, by other means, in a horizontal position, which is easily determined by the vertical adjustment of the level. Move the united eye and middle tube a few degrees round in it to the right and left; and observe whether the bubble, formerly in the middle, now moves to either end of the level tube. If it does not, the lateral adjustment is already made. If it does, correct the observed motion by means of the adjusting screws at *p*. If this adjustment is not made, a slight deviation of the plane of the sextant from the vertical plane, which the observer cannot detect, when shut out from the horizon of the sea, may cause a considerable error in the observed altitude. To prevent this, let a plummet be suspended behind the plane of the sextant, which will readily detect any deviation of the instrument from the vertical plane.

If E, H, the middle tube of the telescope, be moved forward or backward in the object tube, F, B, so as to place the object glass a little too near, or too far from the cross hairs in the centre of the field, the image of the observed object may thus be brought nearer to, or farther from the eye than the intersection of these cross hairs, without causing any apparent indistinctness of the image. In this case, when the eye is slightly elevated or depressed, it will cause the contact of the image with the horizontal hair to appear either too close or too open, and may thereby cause an error of one or more minutes in the observation, according to the distance of the image on either side of the cross hairs.

To avoid this source of error, care must be taken to mark on the middle tube, E, H, a line, $\alpha\beta$, to which the middle tube should be moved, so that the image of a celestial object may be formed exactly at the cross hairs; for then, any elevation or depression of the eye will cause no sensible change of the apparent contact of the limb of the image with the horizontal hair. The proper distance of the object glass is a constant quantity for all celestial objects, but it varies with the distance of terrestrial objects. As considerable care and application are necessary, in order to acquire correctness and facility in the practice of this method of observation, it will be proper, when practicable, that the observer should accustom himself to take observations by this method on shore, before he proceeds to sea.

VARIATION OF THE OPTICAL DECEPTION OF LE CAT.

M. Le Cat has described in his "Traité des Sens," p. 298, a curious optical deception, in which an erect object placed near a hole in a card next the eye, will appear to be on the other side, and also inverted and magnified. Let C, D, (fig. 6,) be a card perforated with a small hole; E, a white wall or window; D, the eye of the observer, and *d* the head of a pin held near the eye, and also near the hole in the card. Under these circumstances, the pin, *d*, will be seen at F, inverted and magnified. The reason of this is, as M. Le Cat has observed, that the eye in this case sees only the shadow of the pin on the retina, and since the light which is stopped by the upper part of the pin or its head comes from the lower part of the white wall or window, F, and that which is stopped by the lower end of the pin comes from the upper part of the wall or window, E, the shadow must necessarily appear inverted with respect to the object.

The following variation of Le Cat's experiment has been described by the writer of this article: Take a common pin and hold it in any position near the eye, so that the observer sees reflected from its head a faint circle of light, then hold a second pin opposite to it exactly, as in fig. 6, and an inverted image of the one pin will be seen in the head of the other. If the head of the first pin is round and well polished, the inverted and magnified image of the other will be more distinct. The little round knob, by the pressure upon which the case of a watch is often opened, will answer better than the finest pin head.

REV. MR. LARDNER'S METHOD OF SECURING CARRIAGE WHEELS.

THIS ingenious contrivance is represented in figs. 3, 4, 5. In fig. 3, A, B, is the part of the axletree on which the wheel revolves; B, C, a stop or spud forming part of the axletree, and *within* which the wheel revolves; and C, D, a screw having a perforation with a linch pin, as shown in fig. 5.

The nave of the wheel is shown in fig. 4, where may be seen the groove, *m*, which receives the stop or spud, B, C. When the wheel is about to be placed upon the axle, this groove must be brought opposite the spud, B, C, (fig. 3,) so as to pass over it. The wheel will then revolve within the spud, and cannot come off the axletree, unless the groove, *m*, first pass over the stop, B, C, during which process the wheel cannot revolve. A slide or wedge, E, F, made to fit the groove exactly, is inserted when the groove is not opposite the spud, so that the wheel cannot come off, unless this slide works out. A collar, G, H, (fig. 5,) with an aperture corresponding to the stop, B, C.

RULES FOR CONSTRUCTING BEVEL WHEELS.

GENTLEMEN,—Should you think the following rules for the construction of a certain kind of bevel wheels, may be serviceable to any of the readers of your valuable Magazine, they are at your service.

The wheels in question are of that kind called *bastard* bevels; that is, a bevel wheel into which two pinions of different sizes are made to work. It will appear evident from the inspection of fig. 7 of the plate, that these pinions will have to be drawn to centres different from each other, and from that of the wheel. Whence it happens, that if the diameters, A B, A E, and B F, be made proportional to the number of teeth in each, and, consequently, the pitch of them all equal, the diameter, L N, of the greater pinion will be greater, and the diameter, M P, of the other will be less than the proportional diameter, N P, of the wheel, and the pitch of the teeth will be unequal in the same proportion.—When the teeth are short, and the difference of the pinions not great, such wheels may work; but if that difference and the length of the teeth be increased to any extent, the wheels will become locked in each other, and will not work at all. To remedy as much as possible this defect, the following method is adopted by millwrights:—The diameters of the two pinions are added together, and half their sum taken for the diameter of a pinion, to which the bevel of the wheel is made to correspond. They then endeavour to make the pitch or proportional diameters of the wheel and pinions to correspond at the middle of the teeth, as at H I, in the figure; and by this method, if the whole be correctly done, whatever difference there may be beween the proportional diameters of the wheel and pinions at the extremities of the teeth, it will be one-half less than it would have been at the point, had they been drawn like common bevel wheels.

But there is still one defect attending this method, which is this: That if the mean diameter, found as before, be taken for the centre of the wheel, the difference between the diameters of the pinions thus found, and the proportional diameters, will, in them both, be equal; but as the small pinion has fewer teeth than the large one, this difference will be divided into fewer parts, and, consequently, each of them will differ more from the pitch of the wheel than those of the large pinion.

By the following rules, this defect is remedied, and the diameters, A E, and B F, may be found by calculation, after which the wheels may be drawn as in the figure.

Let A B, (fig. 7,) the diameter of the wheel at the pitch line, be represented by $2\,b$, and let $a =$ the number of teeth in it; let $c =$ the number of teeth in the greatest pinion, $d =$ the number in the other, and $e =$ half the length of the cog, A H. Also put the perpendicular, D C, $= p$.

Then, should $p = \frac{2\,b\,c\,d}{a\,(c + d)}$. The diameter of the greater pinion, A, E, $= \left(b\,c + \frac{a\,e\,p - b\,c\,e}{\sqrt{b^2 + p^2}}\right) \div \frac{a}{2}$ And the diameter, B, F, of the lesser one $= \left(b\,d + \frac{a\,e\,p - b\,d\,e}{\sqrt{b^2 + p^2}}\right) \div \frac{a}{2}$.

By calculating the diameters of the pinions from these formulæ, the diameters, H G, J O, and H J, at the middle of the teeth, will be proportional to the number of teeth in each, and the difference between the diameters, A E, B F, found as above, and the proportional diameters will be in the ratio of c to d, and, consequently, by whatever quantity the pitch of the pinion at A E is less than the pitch of the wheel, by exactly the same quantity will the pitch of the pinion at B F be greater, and at the point of the teeth, the pitch at N L will be greater, and at P M, less in the same proportion.

The reduction of these formulæ into words, and their application to a particular example, I must defer till another communication.

I am, yours, &c.

T. A.

Gallashiels, 12th April, 1826.

PARALLEL MOTION.

THE different combinations of levers required to produce the various parallel motions used in moving the piston-rods of pumps and steam cylinders, are worthy of notice, as exhibiting some ingenious applications of geometrical principles. The object of the parallel motion is to convert the motion of the end of a reciprocating beam or lever into a vertical or rectilinear motion, or the continuous motion of a crank at once into a reciprocating motion. The simplest and most obvious method of producing either of these effects, is to connect the end of the piston-rod to the beam, or the crank, by means of joints, with a connecting rod, of a proper length, between them, and confine the former to preserve its rectilinear movement, by sliding through a collar, or in grooves. Friction wheels may be used to make it work easily; but in machines which have great strains, the constant wear of the grooves or wheels would then produce looseness, and destroy the parallelism of the motion: recourse must, therefore, be had to parallel levers. The following is a simple application of a series of levers to the piston of a pump:—

If B, C, (fig. 8,) be the pump-rod, the point at which the dotted line intersects the lever will move in a nearly rectilinear direction. Another method of effecting this parallelism may be noticed. It is only necessary to make the piston-rod consist of two parallel bars, having teeth in the side, which front each other. Let a toothed wheel be placed between them, having only half of its circumference furnished with teeth. It is evident, without any farther description, that if this wheel be turned uniformly round its axis, the piston-rod will be moved uniformly up and down without intermission. This has often been put in practice, and the piston-rod made to work between grooved rollers; but the machine always went by jolts, and seldom lasted a few days. Unskillful mechanics attributed this to defects in the execution; but the fault is essential, and lies in the principle. The machine could not perform a single stroke without breaking, if the first mover did not slacken a little, or the different parts of the machine did not yield by bending, or by compression; and no strength of materials could withstand the violence of the strains at every reciprocation of the motion. This is chiefly experienced in great works, which are put in motion by a water-wheel, or some other equal power exerted on the mass of matter of which the machine consists. The water-wheel being of great weight, moves with considerable steadiness or uniformity; and when an additional resistance is opposed to it by the beginning of a new stroke of the piston, its great quantity of motion is but little affected by this addition, and it proceeds with very little loss of motion. The machine must either yield a little by bending and compression, or go to pieces, which is the common event.

IMPROVED WATER-CLOSET.—By Edward Jordan, Norwich.

The improvements which constitute the subject of Mr. Jordan's Patent, are designed to make water-closets what may be called self-acting; that is, to force a quantity of water into the pan, for the purpose of washing away the soil as soon as a person rises from the seat. This object may be effected by adapting the new contrivance in several different ways; but that mode which the patentee prefers is shown in fig. 9 of the plate.

The pan or basin, *a*, with its valves inclosed in the box and the discharge pipe, are not intended to be varied from their usual construction in ordinary water-closets; the improvements being on the parts about to be described; *d* is a pipe leading from a reservoir of water above; from this pipe the water is intended to flow through the stop-cock, *e*, into a cylindrical vessel; *g* is a pipe leading from the stop-cock, through which the water from the cylindrical vessel flows into the pan, the cock, *e*, having three ways.

It is proposed that the seat of

the water-closet shall be made to sink an inch or two when sat upon; in which case, the rod, *h*, placed under the seat, will be made to descend, and to force down the shorter arm of the lever, *i*; by this means, the longer arm of the lever, *i*, will be raised, and with it the rod, *k*, connected to the lever or arm of the stopcock, *e*; hence the play of the cock will be turned round the sixth part of a revolution, opening the way of the pipe, *d*, and closing the way of the pipe, *g*; at this time the water will be enabled to flow from the reservoir above, through the pipe, *e*, and the cock, *d*, into the cylindrical vessel, *f*, which it will fill by the superincumbent pressure of the descending column, *d*, excepting that portion of the cylinder occupied by the compressed air.

On the person rising from the seat of the water-closet, the force of the spring acting upon the longer arm of the lever will depress it, and thereby bring the seat, the rod, and the playcock, *e*, into the situation shown in fig. 9; when the way of the pipe, *g*, being opened, and that of *d* closed, the elastic force of the compressed air in the cylinder, *f*, will expel the water therefrom with considerable force, and inject it into the pan for the purpose of washing away the soil through the valve and stink-trap placed at the bottom in the box, *h*, as usual.

The patentee suggests, that several variations of this contrivance may be made, such as moving the lever and cock by a handle attached to the rod, *h*, instead of a sinking seat; he, however, wishes it to be understood, that he does not confine himself to the precise mode of effecting the movement; but claims particularly the introduction of the three way-cock, in the manner, and for the purpose above explained.

ANDERSON'S INSTITUTION.

"It is hoped the persons who do accept the office, (of Trustee,) will reckon it an honour to be Trustees, as they will be possessed of the power of managing an Institution that may in time be a great benefit to their kindred and their country."—*Prof. Anderson's Will.*

To the Hon. the Lord Provost
of the City of Glasgow.

My Lord,

Having shown in my last letter the situation which you ought to have held over Anderson's Institution, I have again to request your Lordship's indulgence while I make a few remarks on the same subject.

It appears to have been the hope of the venerable founder of this useful Institution, that, after it had been established by the property he had given to the public for that purpose, the wealthy part of the citizens would have contributed towards the promotion of its very important objects in a liberal manner. The Professor had strong grounds for this anticipation. The support which had been so liberally bestowed upon other Institutions in the city, and the interest which was taken in any plan which could promote the "good of mankind," inspired him with a hope, that an Institution for "the good of mankind, and the improvement of science," "for the improvement of human nature, of science, and of the country," would have been cherished and supported in the most liberal manner by the inhabitants of that city, for the benefit of which (more particularly for the operative part of it) it had been established.

The principal object contemplated in the founding of his Institution, was to put a knowledge of the arts, of the sciences, and of literature, within the reach of all classes of the community, whatever their circumstances, or their occupations, or their sex.

Till his time, the manufacturer had no opportunity of acquiring the slightest knowledge of the *principles* upon which his art might depend; the operative had no means of obtaining a knowledge of the *properties* of those bodies upon which he operated; and the plodding man of business, whose avocations occupied the greater part of his time, had no school of science open to him where he might spend a leisure hour, and relieve his mind of the anxieties incident to his profession.

But to accomplish this, and more than this, was the view of Professor Anderson; and he was thus completely justified in calculating upon a generous support from the liberal portion of his fellow-citizens. His views of the benefit which would accrue to the public from his Institution have been fully verified. It has already been the means of disseminating useful knowledge throughout the country, and has given an impulse to its progress which will spread it over the world. Similar Institutions have arisen, or are arising, in all parts of the empire, and are liberally supported; yet that Institution, which is the parent of them all, is destitute of that support from the wealthy, which has been so liberally extended to its offspring!

The great and increasing attendance upon the classes, demonstrate an increasing desire for knowledge; and it is matter of regret, that the place occupied as a lecture-room is so inconvenient; yet it is not in the power of the trustees either to extend the present building, or to procure another more suitable for the purposes of the Institution. This shows, more powerfully than words can do, the great necessity there is of procuring the co-operation of the public.

There is just one way in which I can account for the *apparent* indifference of the public towards an Institution so very useful as Anderson's has been, and which exceeds all others in the purposes for which it was founded, and that is, that no exertions have been made by the trustees or managers to call towards it the attention of the public, nor have they ever but once endeavoured to increase their resources by soliciting the subscriptions of those who might be disposed to assist them in promoting the interests of science.

It appears that in the year 1796, when the Institution was about to be opened, subscription papers were issued, and a few pounds raised to enable the trustees to begin their operations; but from that time to this, it does not appear that the trustees have ever exerted themselves to procure even a single subscription.

In the year 1798, as appears from a small pamphlet, which has been printed apparently for the use of the trustees, some gentlemen purchased for the use of the Institution the buildings which it at present occupies, retaining the property of them in their own hands.

These gentlemen, however, in 1806, got tired of lying so long out of their money, and to reimburse themselves, offered the buildings for sale; and had it not been for the exertions of a few individuals, the Institution would then have received its death-blow. These individuals, however, contrived, by their assiduity, to raise among their friends about £1000, for which they received permanent tickets to the

Natural Philosophy lectures. The trustees then *borrowed* another £1000, on the security of the property, which by these means was secured to the Institution. At other times money has been *borrowed* upon the apparatus, but so far as I have been able to learn, no attempt, except one, has ever been made by the trustees to procure the assistance of the *public;* and that once no less than 30 years ago, and at a time when such an Institution was considered as a foolish speculation.

Your Lordship will thus observe, that notwithstanding the incalculable benefits which the citizens of Glasgow have derived from Anderson's Institution, it has been peculiarly modest in asking their support; that debt upon debt has been accumulated to serve the public and promote their improvement, yet no appeal has ever been made to that public for their assistance in enabling the Institution to extend its advantages, or to give it that degree of independence which ought to be possessed by every Institution whose object is the improvement of society.

I trust, however, your Lordship will agree with me in saying, that such false delicacy should not be entertained by the trustees of an Institution which so well recommends itself to the public support by the peculiarly interesting nature of its objects. Whatever might be the case in former days, there is now a very general disposition among the liberal classes of society to promote the progress of education; and I am fully persuaded that no Institution whose purposes are so much calculated to do good to society as Anderson's is, would be allowed to appeal to them in vain:—why, then, should not Anderson's Institution, which has for 30 years shed its influence over the minds of our citizens, solicit for itself a share of that patronage and support which has latterly been so liberally bestowed upon others of a more recent date?

From a statement in the pamphlet before referred to, it appears that the expenditure exceeds the receipts by more than £20 annually, and yet in this expenditure there is not included any part of the expense of providing the necessary apparatus for the lectures, except the mechanic's salary: there appears, however, to be a small sum in the bank, which, I believe, is part of the founder's bequest, and this is all they have, or, without a subscription, can have, to make up the deficiency in the annual receipts, and provide suitable apparatus for illustrating the subjects lectured upon in the Institution. The expense of procuring suitable apparatus must be very considerable; and when we take into consideration the improvements which are daily making in science and the arts, it will appear evident that this expense must be constantly increasing, if the Institution is supplied, as it ought to be, with the most modern apparatus and models; but their funds can no longer keep pace as they have hitherto done with these improvements; and unless your Lordship step forward with your patronage and support, it will fail in its utility to the public, from the want of proper means of illustration. At present, its apparatus can be boasted of as being the most extensive and complete of any similar Institution in Britain; but without assistance it must soon be left behind.

In referring to the present state of the apparatus, it would be ingratitude to omit calling your Lordship's attention to the unlimited beneficence of *one* of the trustees, to whom the public, but particularly the mechanics of Glasgow, "owe a very large debt of gratitude." Had it not been for his liberality, I could not have said so much as I have done for the Institution apparatus.

Every person who has attended the Chemical lectures must have observed that almost the whole of the apparatus employed in the illustrations, consists of glass vessels, and that a considerable part of the Natural Philosophy apparatus consists of the same material. These, from their brittle nature, require to be often renewed, and a very considerable expense must be incurred by their replacement: yet all this apparatus was provided originally, and still continues to be provided, *free of every expense*, by Mr. Geddes of Verreville! Surely such a man deserves the thanks of the community for his unwearied exertions in behalf of science, and for the advancement of knowledge among the working classes. Since the foundation of the Institution, a period of thirty years, has he continued to watch over its interests with more than a parent's care: he is not one of those who say "be ye clothed," but who give not those things which are needful for the body; he gives with unsparing hand, freely and voluntary; and to him, in connection with Dr. Ure, is Glasgow indebted for the existence of Anderson's Institution at this day. Had not they, with one or two others, exerted themselves in 1806, to prevent a sale of the property, and secure it to the Institution, Glasgow would not, at this day, I am persuaded, have been able to rank it among the noblest of her possessions.

I trust your Lordship will now see the necessity there is for the most vigorous exertion on the part of the visitors and trustees, to interest the public on behalf of the Institution; and to you, my Lord, as its chief guardian, must the friends of the Institution look, in the pleasing hope of seeing your influence exerted to promote its prosperity, and enable it to extend and increase its usefulness. Were your Lordship to set the example, I am confident you would be speedily followed; and I am the more confident that very respectable annual subscriptions would be obtained, when I look to the success of the Edinburgh School of Arts—a school founded on the model of Anderson's, and, in fact, its first-born son. There the public are called upon, and there they subscribe in the most liberal manner.

I have been told, and from my own experience can assert, that many gentlemen in this city would subscribe, were an opportunity afforded them of so doing; but no such opportunity has been given. I trust, however, that your Lordship will, in the exercise of that trust which has been committed to your charge, at an early period, call the attention of the public to the state of its affairs, in such a way as may appear most conducive to the desired end; and by stimulating their liberality, render Anderson's Institution still more useful and interesting than it has even hitherto been, and at the same time enable it to keep pace with the increased desire for knowledge, and the rapid improvements in science. It will be a first appeal, and will not be made in vain.—I am, my Lord, your Lordship's most obedient servant,

A GLASGOW MECHANIC.

15th April, 1826.

ON CAUSE AND EFFECT.

Cause, that from whence any thing proceeds, or by virtue of which any thing is done—it stands opposite to effect. We get the ideas of cause and effect from our observation of the vicissitude of things, while we perceive some qualities or substances begin to exist, and that they receive their existence from the due application and operation of other beings. That which produces is the cause; and that which is produced is the effect: thus, fluidity in wax is the effect of a certain degree of heat, which we observe to be constantly produced by the application of such heat.

Aristotle, and the schoolmen after him, distinguished four kinds of causes; the efficient, the material, the formal, and the final. This, like many of Aristotle's distinctions, is only a distinction of the various meanings of an ambiguous word; for the efficient, the matter, the form, and the end, have nothing common in their nature, by which they may be accounted species of the same *genus;* but the Greek word, which we translate *cause*, had these four different meanings in Aristotle's days, and we have added other meanings. We do not indeed call the matter or the form of a thing its cause; but we have final causes, instrumental causes, occasional causes, and many others. Thus the word *cause* has been hackneyed, and made to have so many different meanings in the writings of philosophers, and in the discourse of the vulgar, that its original and proper meaning is lost in the crowd.

With regard to the phenomena of nature, the important end of knowing their causes, besides gratifying our curiosity, is, that we may know when we are to expect them, or how to bring them about. This is very often of real importance in life; and this purpose is served, by knowing what, by the course of nature, goes before them and is connected with them; and this we call the *cause* of such a phenomenon.

If a magnet be brought near to a mariner's compass, the needle, which was before at rest, immediately begins to move, and bends its course towards the magnet, or perhaps the contrary way. If an unlearned sailor is asked the cause of this motion of the needle, he is at no loss for an answer. He tells you it is the magnet, and the proof is clear; for, remove the magnet, and the effect ceases; bring it near, and the effect is again produced; It is evident to sense, that the magnet is the cause of this effect.

A Cartesian philosopher enters deeper into the cause of this phenomenon. He observes, that the magnet does not touch the needle, and can give it no impulse. He pities the ignorance of the sailor. The effect is produced, says he, by magnetic effluvia, or subtile matter, which passes from the magnet to the needle, and forces it from its place. He can even show you, in a figure, where the magnetic effluvia issue from the magnet, what round they take, and what way they return home again. And thus he thinks he comprehends perfectly how, and by what cause, the motion of the needle is produced.

A Newtonian philosopher inquires what proof can be offered for the existence of magnetic effluvia, and can find none. He holds it as a fiction, a hypothesis, and he has learned that hypotheses ought to have no place in the philosophy of nature. He confesses his ignorance of the real cause of this motion, and thinks that his business as a philosopher is only to find, from experiment, the laws by which it is regulated in all cases.

These three persons differ much in their sentiments with regard to the real cause of this phenomenon; and the man who knows most, is he who is sensible that he knows nothing of the matter. Yet all the three speak the same language, and acknowledge that the cause of this motion is the attractive or repulsive power of the magnet.

What has been said of this, may be applied to every phenomenon that falls within the compass of natural philosophy. We deceive ourselves, if we conceive that we can point out the real efficient cause of any one of them.

The grandest discovery ever made in natural philosophy was the law of gravitation, which opens such a view of our planetary system, that it looks like something divine. But the author of this discovery was perfectly aware that he discovered no real cause, but only the law or rule according to which the unknown cause operates. Natural philosophers, who think accurately, have a precise meaning to the terms they use in the science; and when they pretend to show the cause of any phenomenon of nature, they mean by the cause a law of nature, of which that phenomenon is a necessary consequence.

The whole object of natural philosophy, as Newton expressly teaches, is reducible to these two heads: first, by just induction from experiment and observation, to discover the laws of nature; and then to apply these laws to the solution of the phenomena of nature. This was all that this great philosopher attempted, and all that he thought attainable. And this, indeed, he attained, in a great measure, with regard to the motions of our planetary system, and with regard to the rays of light.

But supposing that all the phenomena which fall within the reach of our senses were accounted for from general laws of nature, justly deduced from experience; that is, supposing natural philosophy brought to its utmost perfection; it does not discover the efficient cause of any one phenomenon in nature.

The laws of nature are the rules according to which the effects are produced; but there must be a cause which operates according to these rules. The rules of navigation never navigated a ship. The rules of architecture never built a house.

Natural philosophers, by great attention to the course of nature, have discovered many of her laws, and have very happily applied them to account for many phenomena, but they have never discovered the efficient cause of any phenomenon; nor do those who have distinct notions of the principles of the science make any such pretence.

COMPARATIVE ANALYSIS OF BLACK AND GREEN TEA.

A VARIETY of experiments, made in the laboratory of the Royal Institution of Great Britain, were chiefly undertaken with a view of ascertaining whether the different effects usually attributed to black and green tea, are referable to any peculiar principle existing in the one, which is not to be found in the other. To ascertain the nature and extent of adulterations of any kind was not the object; the various specimens submitted to examination were obtained from most respectable sources, and undoubtedly genuine as imported: what process the tea may be submitted to in China, or what mixtures and additions it may there receive, are curious and interesting matters of inquiry, and deserve further investigation than they have as yet received.

The experiments show that the quantity of astringent matter precipitable by gelantine is somewhat greater in green than in black tea, though the excess is by no means so great as the comparative flavours of the two would lead one to expect. It also appears that the entire quantity of soluble matter is greater in green than in black tea, and that the proportion of extractive matter not precipitable by gelantine is greatest in the latter.

Sulphuric, muriatic, and acetic acids, but especially the first, occasion precipitates in infusions both of black and green tea, which have the proportions of combinations of those acids with tan. Both the infusions also yield, as might be expected, abundant black precipitates with solutions of iron; and when mixed with acetate, or more especially with sub-acetate of lead, a bulky buff-coloured matter is separated, leaving the remaining fluid entirely tasteless and colourless. This precipitate was diffused through water, and decomposed by sulphuretted hydrogen; it afforded a solution of tan and extract, but not any trace of any peculiar principle to which certain medical effects of tea, especially of green tea, could be attributed.

One property of strong infusions of tea, belonging equally to black and green, seemed to announce in them the presence of a distinct vegetable principle, namely, that they deposit, as they cool, a brown pulverulent precipitate, which passes through ordinary filters, and can only be collected by deposition and decantation; this precipitate is very slightly soluble in cold water of the temperature of from 50 deg. downwards, but it dissolves with the utmost facility in water of 100 deg. and upwards, forming a pale brown transparent liquid, which furnished abundant precipitate in solutions of isinglass, of sulphate of iron, of muriate of tin, and of acetate of lead—whence it may be referred to consist of tannin, gallic acid, and extractive matter.

When tea leaves have been exhausted by water repeatedly affused, the above experiments show that alcohol is still capable of extracting a considerable quantity of difficultly soluble matter; this substance again infused in boiling water dissolves with difficulty, furnishing a liquid which smells and tastes strongly of tea, and which, were it not for the expense of the solvent, and the trouble attending its separation, might perhaps be profitably employed.

Though the above experiments show that tea contains, upon an average, from 30 to 40 per cent. of matter soluble in boiling water, it is not to be supposed that so large a proportion is taken up in the ordinary process of making tea; on the contrary, from tea leaves in the state in which they are usually thrown away, there is still contained from 10 to 14 per cent. of soluble matter, capable of affording a sufficiently pleasant beverage, though it must be granted, that the most agreeable portion of the tea, consisting probably of the purer tannin, or astringent matter, and of the whole of the aroma, is taken up by the first affusion of hot water; and that, subsequently, the bitter and less soluble extractive matter is dissolved, furnishing what is usually called strong tea, but infinitely less agreeable than the earlier infusion. Hence it is that the real epicure in this article imi-

n some measure, the Chinese
s of infusion; and only drinks
st made tea, using a fresh,
all proportion of the leaves
h successive cup.
e of Dr. Lettsom's experi-
would seem to show that the
s effects of tea are referable
volatile and odorous principle
passes off in distillation;
thinks that those who suffer
from them, but yet cannot omit this favourite beverage, might take it with more safety if previously boiled for a few minutes to dissipate the fragrant principle. In all the forms which Du Halde relates for administering tea as a stomachic medicine among the Chinese, it is either to be boiled, or otherwise so prepared as to dissipate its fragrancy.

BRONZE STATUES.

reparation of an alloy, homo-
is and equal in all its parts,
purpose of casting statues
onuments, is a chemical, or
metallurgical operation of
great difficulty. In France,
this art has of late years
extensively practised, there
ree instances of failure in
modern times. During the
of Louis XIV. the most cele-
statuaries in bronze were
rs of the name of Keller,
eir works were completely
eneous in the composition of
loy, and of great beauty of
tion. More lately, and even
nce theoretical chemistry has
cultivated to a great extent
nce, this branch of art has
practically less attended to,
s known, and produced the
ing failures:—

TATUE OF DESAIX.

execution of this statue was un-
en by contract, and the sum to
for it was 100,000 francs, exclu-
the bronze. The contractor
into an agreement with a person
med to cast bells and such things,
dertook to perform the whole for
francs; but that he might be as
ical as possible, he bargained
he sculptor was not to interfere
is modelling. The first attempt
ing completely failed, owing to
me giving way in which the sand
t, and a considerable quantity of
was lost. The artist next attempted to cast it in separate pieces, but from not ascertaining that all the portions of the metal were mixed in the same proportions, and from not taking the contractions on cooling into consideration, the pieces were all of different qualities, and did not unite well with each other. He did indeed unite them, but the proportions were so altered, the faults being so great, that they could not be repaired by the chisel, and the monument, as a work of art, was a disgrace to the city of Paris. At a subsequent period it was removed, and afterwards recast to form the statue of Henry IV. in making which almost as great errors were committed. At the erection of the CELEBRATED COLUMN IN THE PLACE VENDOME, similar faults were committed. This column was erected by order of Buonaparte, in commemoration of the victories of the French armies, and it was cast out of cannon taken from the Austrians and Russians in 1805. The whole weight of the different pieces of bronze composing it was 900,000 *kilogrammes*, or very nearly 2,000,000 lbs. avoirdupois. The contract for the performance of the work was made with an iron founder, who undertook the whole, carving and all, for 1 *franc* a *kilogramme*. M. Darcet, the celebrated chemist, tendered some good advice on the occasion, which was rejected, and the contractor had a foundry built, at a considerable expense. He employed a furnace for melting iron, and being ignorant of the fusion of bronze, he failed in his first attempts to cast the large pieces for the base of the column. At each operation he altered the proportion of the alloy, by oxidizing the tin, the lead, and the zinc, the oxides passing into scoria, or being partly carried

off by the burning air. He did not perceive this, and delivered the different pieces of different qualities, but all of them contained a greater proportion of copper than the bronze of the guns. When the column was about two-thirds finished, he found his supply of metal exhausted; and so sure had he been of having enough, that he had previously sold part of the 10 per cent. allowed him for waste, under the idea that it would be more than sufficient. Being obliged to complete the work with the quantity of metal delivered to him, he was placed in a disagreeable situation. Under these circumstances, he endeavoured to cast the white metal obtained by reducing the scoria, and a quantity of old brass he purchased at a low price. The castings he obtained by mixing these materials were full of bladders and spotted with lead; they were at first of a dirty grey colour, and afterwards became black. Such defective work could not pass, the labours of the undertaker were put a stop to, his foundry was sealed up, and the man ruined.

By dint of reclamations, he procured the appointment of a commission to examine his accounts. The commissioners wished to know the proportions of the different metals in the guns delivered to him; but this point had not been ascertained, and therefore the most important element for coming to a correct conclusion could not be obtained. The weight of each piece of casting delivered by him was known; and by taking morsels from them all, and melting them into one piece, an ingot was obtained representing the mean composition of the whole column. After ascertaining this, and knowing the general proportion of the alloys of which cannon are constructed, the commissioners agreed in opinion, that the mean alloy of the column was equal to that delivered to the contractor. By analysing the different pieces, it was found that the large pieces of the pedestal contained only 6 per cent. of alloy, while the small pieces of the shaft and column contained 21. It was therefore evident, that the contractor, not understanding the nature of bronze, had refined his alloy in the first instance by repeated meltings; and having thus diminished very much the total weight, was obliged to have recourse to the means already described. At the commencement of his operations, he had delivered the pieces with too much copper, and at the end with too little. The pieces were, after all, so badly executed, that above 140,000 lbs. of bronze were cut away by the sculptor, who was, moreover, paid 300,000 francs for his labour.

USEFUL RECEIPTS.

German Cement for Mending Glass and China.—Reduce separately to the finest powder, equal quantities of unslacked lime and flint glass, and as much lithage as both of them together, the proportions to be adjusted by measure, when reduced to powder. Mix them well together, and work them up into a thin paste, with old drying oil. This cement or paste, which is very durable, will even acquire a greater degree of hardness when immersed in water.

Varnish for Prints or Maps.—Take isinglass 4 ounces, separate it into small pieces, boil it in a quart of brandy or other strong spirit; when it becomes the consistence of strong glue, by being a little exposed to the air, it will be ready for use. With this glue, while hot, wash over the print as quick as possible, and let it stand for a day or two to dry well; do this two or three times, when it should be varnished with the white varnish, made as follows. Should it at any time afterwards be soiled by flies, &c. it may be washed with a sponge and clear water.

The white varnish is usually made of gum sandarac and gum mastic, dissolved in spirits, and left two days to settle, then strained through a linen cloth, and after standing some time, the clear poured off and bottled for use.

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THE GLASGOW
MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

" All art is founded on science, and the science is of little value which does not serve as a foundation to some beneficial art."—*Dr. Campbell.*

No. CXXIII. *Saturday, 29th April,* 1826. Price 3*d.*

EGELL'S IMPROVED STEAM ENGINE; WADDLE'S PUNT BOAT; &c.

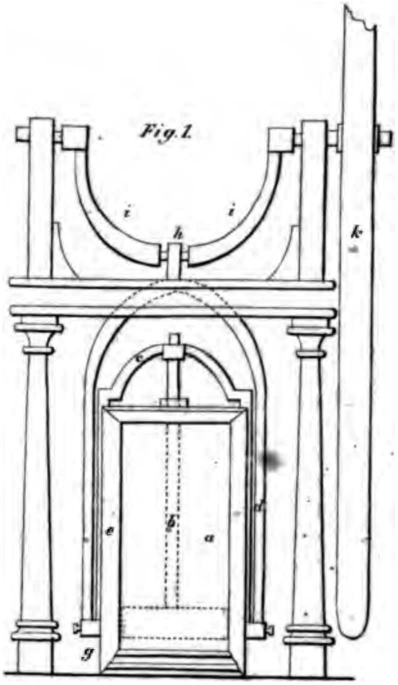


Fig. 3.

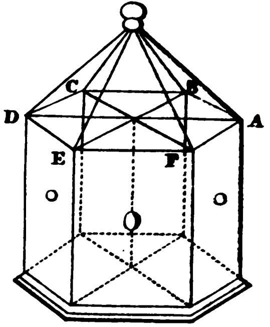
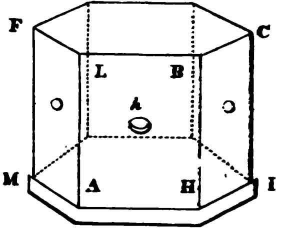
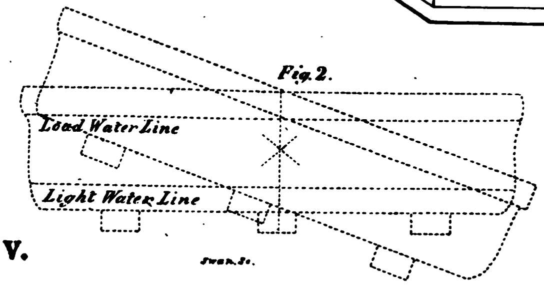


Fig. 4.





IMPROVED STEAM ENGINE,

BY FRANTZ ANTON EGELLS OF BRITTANIA TERRACE, CITY ROAD, MIDDLESEX.

MR. EGELLS has obtained a patent for an improved steam engine. In this engine, he dispenses with the parallel motion, as connected with the action of the piston of a steam engine, by which a main oxillating beam is rendered unnecessary, consequently an important saving of materials, and of expense in the erection is effected, and the friction of the parts considerably reduced; the whole being rendered more compact than the mechanism of other engines, constructed to exert the same measure of power. Fig. 1. of the plate, and a short description will explain this part of the improvement. *a* is the cylinder, within which is the working piston shown by dots; the steam-pipe and condensing-pipe are not represented as connected to the cylinder, being the same as are employed in ordinary engines; *b* is the piston rod working into a suitable stuffing box; *c* is a cross beam fixed to the top of the piston rod; to this beam is connected the two rods *d*, which work up and down perpendicularly with the piston, between the guides *c*. At the lower ends of the rods *d*, pivots extend to which the vibrating bridle frame is attached at *g*. The top of this bridle frame at *h*, being connected by a joint to the crank *i*, gives motion to the crank and its axle or main shaft, and the fly wheel *k*, as the piston works up and down.

The other parts of the engine, as shown in the specification, exhibit only what the patentee considers to be a compact, eligible, and convenient arrangement of the parts; but nothing new in principle is proposed, as with slight variations of position and form the parts are all common to other engines.

The particular advantages proposed under this patent are a saving of metal and workmanship in the construction of a steam engine; the convenience of being enabled to get at every part to perform repairs in case of its sustaining any injury; that engines of very great power may be constructed upon this plan, without requiring strong buildings to contain them, as all the parts are made fast to the ground on which the engine stands; and lastly, if employed for the purpose of navigation, where a large fly-wheel would be inconvenient, two of the engines may be combined in such a way, that their cranks may stand at right angles to each other, and thereby enable the actions of the engines to balance each other; under such circumstances the condenser, air pumps, hot and cold water pumps, cisterns, &c. may occupy the middle part between the two engines.

DESCRIPTION OF A SIMPLE PUNT BOAT FOR SAVING TIME AND LABOUR.

BY ANDREW WADDLE, ESQ. F. R. S. E.

THIS Punt Boat is shown at Fig. 2. It is 60 feet long, 16 feet broad, and 4½ feet deep.

It carries its lading upon deck, and it is for the purpose of transporting stones and other materials for constructing wears or break-waters, and for removing obstructions in dry and bad harbours.

In the interior of the boat below

the deck, there is a water tight space built on one side, occupying about one third the breadth of the boat, and the whole of the length, which space has no connection with any other part of the interior.

In the bottom of this space, there is an opening with a valve to shut at pleasure, capable of admitting as much water in one minute as will sink down that side of the boat and raise the other, thereby forming an inclined plane, and admitting of the stones or other materials on the deck of the boat sliding easily over board into the water, after the manner in which a loaded cart is emptied.

The boat will then instantly resume nearly its upright position, and the valve being left open, the water that was admitted into the above mentioned space, will run out again to the level of the water without. The valve is then to be shut, and any water that remains in the space, pumped out in a few minutes by means of a wide chambered pump, and the aid of one man.

A boat of this construction will be most useful in forming breakwaters, by dropping stones at high water, or at any time in deep water, exactly on the spot wanted; but the abovementioned valve should be made to open and shut with a screw, so that should the lading be required to be put overboard at different parts, the side of the boat might be sunk no farther than to admit of a man sliding the stones down one after another.

This boat when light draws about one foot and ten inches, and when loaded, about 4 feet water, which difference of two feet and two inches when immersed will displace a body of water equal to 36 tuns weight or more.

The bilge keels attached to the bottom of the boat, are for the purpose of preventing in some measure its flat bottom from coming in too close contact with the mud when deeply laden, which otherwise might prevent the boat from rising with the flood tide, when grounded in such situations; and these bilge keels being firmly united to the bottom of the boat serve to strengthen the whole of its frame.

* * *

THE CISTULA.

THE Cistula is a machine or apparatus whereby little bodies are represented extremely large, and near ones extremely wide, and diffused through a vast space, with other agreeable phenomena, by means of mirrors, disposed by the laws of catoptrics, in the concavity of a kind of chest.

Of these there are various kinds, accommodated to the various intentions of the artificer; some multiply the objects; some deform; some magnify, &c. The structure of one or two of them will suffice to show how many more may be made.

If we wish to make a catoptric cistula to represent several different scenes of objects, when viewed at different holes, it is only necessary to provide a polygonous box, of the figure of the multilateral prism, A, B, C, D, E, (fig. 3,) and divide its cavity by diagonal planes E, B; F, C; D, A; intersecting each other in the centre into as many triangular locules, or cells, as the chest has sides. Line these diagonal planes with plane mirrors: in the lateral planes make round holes, through which the eye may peep within the cells of the box. The holes are to be covered with plain glasses, ground within-side, but not polished, to prevent the object, in the cells, from appearing too distinctly. In each cell are to be placed the different objects, whose images are to be exhibited; then covering up the top of the box with a thin transparent membrane, or parchment, to admit the light, the machine is complete.

For, from the laws of reflection, it follows, that the images of objects, placed within the angles of mirrors are multiplied, and appear some more remote than others; whence the objects in one cell will appear to take up more room than is contained in the whole box. By looking, therefore, through one hole only, the objects in one cell will be seen, but those multiplied and diffused through a space much larger than the whole box; thus every new hole will afford a new scene: according to the different angles the mirrors make with each other, the representations will be different: if they be at an angle greater than a right one, the images will be monstrous, &c.

The parchment that covers the machine, may be made pellucid, by washing it several times in a very clear ley, then in warm water, and bracing it tight, and exposing it to the air to dry. If it be desired to throw any colour on the objects it may be done by colouring the parchment. Zahnius recommends verdigrise ground in vinegar, for green; decoction of Brazil wood, for red, &c. He adds, that it ought to be varnished, to make it more pellucid.

Let me now, however, point out how to make a catoptric cistula to represent the objects within it prodigiously multiplied, and diffused through a vast space. To construct this amazing apparatus, take a chest, as before, but without dividing the inner cavity into any apartments, or cells; line the lateral planes C, B. H, I; B, H, L, A; A, L, M, F; &c. (fig. 4,) with plane mirrors, and at the foramina, or apertures, pare off the tin and quicksilver, that the eye may see through: place any objects in the bottom M, I, as a bird in a cage, &c.

Here the eye looking through the aperture *h*, will see each object placed at bottom, vastly multiplied, and the images removed at equal distances from one another. Hence, with a large multangular room, in a royal palace, lined with large mirrors, over which were plain pellucid glasses to admit the light, it is evident the effects would be very surprising and magnificent.

MEASUREMENT OF A SHIP'S WAY.

THE quarter and half-minute glasses in general used for measuring a ship's way, have always been found very irregular. This irregularity arises from various causes, and particularly the state of the atmosphere at different times, and in various latitudes, and even when they are new, it is scarcely possible to find two that will run out in the same time.

As the log-line is in general used for measuring a ship's way, it is evident that so inadequate a method of ascertaining the portion of time required, must introduce many errors into the estimate made of the velocity and progress of the vessel, and a small, simple, and correct machine that can be depended upon for this purpose appears to be a very desirable improvement.

A small machine invented by Mr. Newman, and which has had the decided approbation of many naval officers appears to possess every requisite for the purpose to which it is intended to be applied.

It is enclosed in a round box 3 inches and ½ in diameter, and 1½ in depth. It has a dial, the circumference of which is divided into 60 parts. In the centre is an index which is carried round by the machine once in 60″ in 1′. At the 15th, 30th, 45th, and 60th second are holes made in the dial through which pins are pushed up or down by small buttons on the outside. The dial is covered in by a strong glass.

When the machine is used, being wound up, the index is to be retained at 60″ by putting the pin at that division. If then 15″ are to be counted, the pin at 15″ is to be put up, and the moment the log is delivered that at 60″ depressed; the index immediately advances and continues in motion until stopped at 15″. If 30 or 45, or 60 seconds are to be told, the pin belonging to the number required is to be put up, and the time told as before.

The beats of the machine can be heard at a considerable distance; and the moment at which it stops so readily distinguished that it may be used as well in a dark night as during day, or by a light; and as it is perfectly accurate, very strong and very portable, it seems well adapted to supply the place of the cargo of incorrect minute glasses at present taken out by vessels.

METHOD OF CONDENSING WOOD, AND GIVING IT A CLOSENESS OF GRAIN FOR RESISTING MOISTURE, IN THE CONSTRUCTION OF FURNITURE AND OTHER PURPOSES.

By Mr. James Falconer, Astile.

This useful process, for which the inventor has taken out a patent, consists in cutting the timber into planks with parallel surfaces. These planks are passed between parallel iron or steel rollers with highly polished surfaces which condense the wood by their pressure. The pressure thus applied must be at first small, and afterwards gradually increased otherwise the wood will be crushed or split. The best way of applying the principle is to place several pairs rollers behind each other, the distance between each pair progressively diminishing. The sap or moisture will thus be forced out of the pores of the wood, and the ends and sides of the plank; and they will thus be rendered stronger, heavier and harder, and less pervious to moisture than in their natural state. When used in furniture, it is less liable to scratch and does not shrink. Oak and mahogany admit of much more compression than fir or other slight woods, and Honduras mahogany may be rendered as hard and heavy as the best Spanish. If one of the rollers is sufficiently bright a finished polish will be left upon the surface. This plan is particularly useful in ship carpentry, for making wooden bolts, trenails, and dowels of a compact quality.

COLOSSAL SPUNGE.

A production has been discovered in the island of Singapore lately *inhabited by the English*, which has been considered as a marine plant, and by the Indians called a sounge. It has the form of a cup or rather of a goblet, supported on a cylindrical foot expanded at the base, and attached to the soil of the shore by an irregular expansion. It is composed of tubes or cellules of various diameters, the apertures being covered with radiated cotton like fibres. The circumference of the cup at the upper part is 4 feet 3 inches; at the middle it is 3 feet 1 inch; and at the bottom only 22 inches and a half; the circumference of the stem at the foot is 17 inches. The cavity of this singular vase can contain 36 quarts. Colonel Hardwicke has ascertained that this production is a sponge formed by marine animals, and analogous to that which is described in the Wernerian transactions under the name of *scypha*, with the exception of difference in dimension. This sponge is not flexible like the officinal species, and the name of *spongia patera* has been proposed for it.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

SECTION I.

By the arrangement which I have adopted, many of the details which, in most of the treatises on Bleaching are given under the present head, have been anticipated, a circumstance which, I hope, will render our account of the processes more perspicuous than it could otherwise have been made; it will, at least, make it greatly shorter. An outline of the processes of Bleaching about half a century ago will be found in the history, p. 267, vol. 3d. by comparing which with the following, an idea may be formed of the rapid march of improvement. I begin with the processes for bleaching piece goods and heavy cotton cloths, which do not materially differ except in the repetition of immersions, the cottons requiring fewer than the linens.

1. *Steeping.*—This process is intended to remove, without the expence of fresh alkaline ley, the impurities which the goods may have contracted in passing through the previous stages of manufacture from the spinner and the weaver, and which the subsequent management *might tend to fix.* Flax is mostly spun by hand, and the spinner constantly moistens it with saliva to make it draw out more readily to the proper grist. Now as saliva is known to be a more universal solvent than even water, we may infer that many impurities may, by this means, be fixed in the yarn. It will also from its nature form, when dry, a pellicle of tenacious matter on the surface of the threads, and may thus prevent the solvents from coming into contact with the colouring matters which are lodged in the body of the thread. Cotton again being spun by jennies and thistle frames is not liable to such regular contamination, but it is sometimes stained by the oil which is used for the machinery. Both are also filled with impurities by the weaver, who finds that he cannot make good work unless he previously dress the yarns with some gelatinous matter that may give it a stronger adhesion. The linen weaver commonly uses for this purpose a sour paste, made from the seeds of oatmeal, which is applied with a brush to the yarn; and then thoroughly dried in by

passing a hot iron over the web. He then takes a brush on which he has rubbed a small quantity of tallow and goes over the whole. The cotton weaver seldom uses the flummery paste, but prefers one made of flour, or of mashed potatoes in a state of fermentation, and sometimes a mixture of both: and the combustibility of the cotton will not permit him to use so expeditious a mode of drying as the hot iron affords. He dries his web with a large fan, and afterwards goes over it with the grease brush in the same way as the linen weaver. I was astonished to read in Mr. Parkes' Essays on Bleaching, (Vol. IV. p. 121.) that the weaver "*melts a quantity of grease over his warp which he afterwards spreads with a brush*:" a thing which I am persuaded no weaver would ever be so foolish as to try, as the parts where the grease fell would do away all the effects of the previous dressing. For this reason weavers are always very carefull not to rub too much grease on their brushes. Mr. Parkes must therefore find some more likely account of the origin of copper stains.

The small quantity of grease in the cloth is fixed by the subsequent operation of singeing when this is had recourse to, and if this is not taken out in the previous processes of bleaching, it will not yield afterwards to the usual processes of ashing and souring.

For the removal of these impurities, the first thing to be done is to have the cloth thoroughly washed, (with soap if neccessary,) by the dash wheel to get rid of what may be loosely attached to it. If time can be spared it would render this washing more effectual to have the goods disposed in very open folds to prevent unequal compression, and soaked in water either in a trough, or in a running stream. (Des Charmes. p. 95.) They are next placed in similar foldings in a kieve which is filled with water or waste alkaline or soap leys at a blood heat, with which they must be sufficiently covered and held down by the cross bars formerly described; for they soon begin to swell and rise above the surface when this is neglected. Osier twigs must be placed at the bottom to prevent this swelling from causing too much pressure. A smaller degree of heat than that mentioned would not readily dissolve the dressing and a greater might coagulate and fix it in the cloth. In a short time the dressing mixes with the water, and from its previous acidity induces the acetous fermentation. An intestine motion becomes perceptible, the temperature increases, and air bubbles are emitted which by carrying up to the surface some of the light oleaginous particles produce a thick scum. These effects however are gentle and slow as the dressing is in small quantity, in proportion to the water. The acid salts, according to Dr. Home, are no sooner separated by the acetous fermentation, from the absorbent earth which made them not perceptible to the tongue in their former state, than they are united to the oily particles of the tallow which likewise adhere superficially, dissolve them and render them in some degree miscible with water. In this state they are soon washed off by the intestine motion of the liquor. This fermentation continues from twelve to eighteen hours, according to the state of the weather; but even in summer may be allowed, if we may trust Des Charmes, to go on without inconvenience for forty-eight hours. It is known to have continued the proper time when an infinity of white bubbles are seen on the surface and a faeted smell is perceived; or when the goods have assumed a clear yellowish colour instead of grey or brown. When no more air bubbles rise to support the scum, it separates, is precipitated, and would again become attached to the cloth if it be not timeously removed. But greater danger may be apprehended from the putrid fermentation taking place which would both weaken the texture of the cloth, perhaps rot it, and also generate and fix a dark colouring matter that it might be difficult afterwards to remove. Attention to the indications now given will prevent such serious accidents.

There has been some discussion and difference of opinion respecting the liquid most proper for steeping. Waste alkaline leys are most commonly used, from our idea that they produce the strongest fermentation; but this, if it be the case, may arise from the impurities with which they are loaded. For fine calico bleaching they certainly ought not to be used, as indelible stains may be the consequence. The alkaline salts may attract the acid salts generated by the fermentation, and prevent their combination with the oleaginous impurities. On the contrary, if the alkaline salts are not previously saturated they may be of use in combining with, and carrying off the tallow. Dr. Home tried to come to some decision on this subject, but his experiments proved unsatisfactory. Des Charmes used milk of lime with advantage. He allowed the goods to remain in this liquid not longer than five or six hours, when they were found sufficiently prepared for the subsequent processes. Water however when time can be spared is as efficacious as either this or an infusion of bran which has also been recommended—to this a decided preference is given in Ireland—(*Dub. Rept.* 1791.)

When the goods are found to be sufficiently steeped, the *steep* is to be drawn off and the goods taken to the squeezers, in order that all the loosened impurities may be pressed out. They are then taken to the dash wheel and washed till the water come off clear, when they are either wrung to such a degree that they may remain only moist, or are left to drain on a proper stage. After rinsing or clearing piece goods subsequent to steeping, particular attention ought to be paid to rubbing them well with black soap, especially along their selvedges, for this part being closer wrought than the rest requires to be particularly cleared to open it to the action of the succeeding detergents. When this is not attended to, it may probably be necessary, after the several operations, to rub them separately by hand, and the bleaching would be retarded by requiring several extraordinary immersions, to prevent these parts from being less perfectly white than the rest. Cottons which have received stains of oil are best cleared by a hot solution of black soap.

MODIFICATION OF ALBUMEN.

CERTAIN observations made by M. Colin, relative to the appearances of albumen when acted upon by different agents, led him to conclude that the substances in some of their states are analogous to that observed by M. Vauquelin in the waters of Vichy, and also have some relation to the animal substance discovered by M. Longchamp in mineral water, and by him called *Barregine.*

In operating with acids upon albumen in experiments on fermentation, he found that it acquired a blue colour when digested with sugar-water, and camphoric acid, at a gentle heat for a few moments. The heat was sufficient to coagulate a little of the albumen. Blue, green, and red colours have also been obtained by treating albumen with dilute sulphuric acid, then concentrating the liquor till it gelatinized, afterwards throwing it upon a filter, and washing it for a long time: after some days the filter became coloured blue in some places, and in others red and green. An aqueous solution of albumen, precipitated by muriatic acid, and washed in a filter, became of a fine red colour. This may also be produced at pleasure by albumen and sulphuric acid, and M. Fremy has shown a red liquor obtained in this way.

These facts tend to establish the possibility of reproducing the animal matter found in the Vichy waters, for this body has also the property of becoming blue, and according to M. Vauquelin, it otherwise agrees with albumen. They also appear equally to show the possibility of converting albuminous matter into the colouring matter of the blood. Certainly the red substance thus produced is insoluble, but it is known that treatment by acids also renders the red colouring matter of the blood insoluble. The study of these phenomena would probably prove very interesting. *Ann. de Chimie xxx.* 323.

ON THE MUTUAL DECOMPOSITION OF BODIES.

BY M. GAY-LUSSAC.

WE owe to Berthollet the important law, that bodies of analogous properties displace each other mutually from their combination, and that the principal causes which limit their separation are volatility and insolubility. Perhaps Berthollet has not sufficiently developed the consequences of this law, but it is easy to state them in each particular case.

When two acids act on a base, the whole resting in solution, the base is divided between them, not according to their ponderable quantity, but according to the number of their atoms; and it does not seem that its affinity for each acid has, in general, any great part in the phenomena. It is sufficient for the division of the base, that the acids, whatever their difference of volatility and solubility, remain in solution, for then they should act as if they enjoyed these two properties in the same degree.

Suppose, for instance, that excess of chloride acid is poured into solution of chloride of soduim, muriatic acid and chlorine will immediately appear in the mixture; and if heat be applied, the choloride soon becomes nitrate of soda. On inverting the experiment, *i. e.* treating nitrate of soda by muriate acid in excess, it will readily be converted into a chloride.

These reciprocal decompositions are very easy, and by converting two nitrates into chlorides, we may easily determine the proportions in which they are mixed; we merely have to know the weight of the two chlorides, and the two nitrates, and the atomic weight of each salt. All the chlorides are not decomposed with equal facility by nitric acid; the chloride of silver, which is completely insoluble in water and in acids is not touched; and that of calcium is more refractory than those of potassium or sodium. But it must be observed, that we here compare compounds, as the chlorides and nitrates not analogous in their nature, and that the law under consideration cannot apply to them, except as we consider the chlorides as remaining in solution indifferently as muriates or chlorides; and this is not always the case. Sulphuric acid, at common temperature, partly separates boracic and arsenic acids from their combinations; but at a high temperature it is expelled from combinations by those acids.

Nitric and muriatic acids decompose the fluorides, but nitrates and muriates are in turn decomposed by flouric acid.

Acetic acid decomposes many chlorides, and reciprocally muriatic acid decomposes many acetates. Many other vegetable acids, and particularly the lactic, present the same phenomena.

Gases soluble in water, and separable in vacuo, are all expelled from the liquid by another gas passed in excess.

Numerous other facts of a similar kind may be quoted, but we confine ourselves to the cases of decomposition of a hydrosulphuret by carbonic acid, and of carbonates by sulphuretted hydrogen, on which M. Henry has experimented at length, to demonstrate what the simple consideration of the laws of Berthollet would have shown.

The bi-carbonate of potash, for example, exposed in solution to contact of air, loses a portion of its acid, and acquires the power of precipitating sulphate of magnesia. If a current of sulphuretted hydrogen gas of which the acid properties, as is known, are nearly the same as those of the carbonic acid, be passed through it, a portion of carbonic acid will necessarily be liberated; and, as it will be carried off by the current of sulphuretted hydrogen, the bi-carbonate will always remain in the same circumstances of decomposition, and by degrees the latter will be completed.

In the same way, by passing a current of carbonic acid gas through a hydro-sulphuret, the latter will be partially decomposed, the sulphuretted hydrogen set at liberty will be carried off by the carbonic acid current; the decomposition of the hydro-sulphuret will therefore be successive, and ultimately complete. It must be remarked, that these decompositions require a quantity of acid far greater than that necessary to saturate the base, for the acid eliminated can escape from the solution only by means of the excess of acid which replaces it, according to the theory of vapours.

It is to be observed, also, that if the carbonate and hydro-sulphuret be not in the state of bi-salts, a disengagement of their acids does not commence until they have arrived at this state. Mr. Henry has observed, that the insoluble carbonates are decomposed, but in a very slight degree, by sulphuretted hydrogen, and this is easily comprehended; but that which is not so necessary a consequence is, that, according to the same experiments, the carbonates are decomposed with greater difficulty by sulphuretted hydrogen than the hydro-sulphurets are by carbonic acid.

CURIOUS LAWS RESPECTING THE VIBRATION OF PENDULUMS.

THE very curious law, of which we propose to give a brief notice, has been discovered by Davies Gilbert, Esq. M. P. and explained in the *Quarterly Journal*.

As it appears from a very simple calculation, that every inch of variation in the barometer must change about two-tenths of a second the daily rate of a clock with a brass pendulum, in so far as buoyancy is alone concerned, Mr. D. Gilbert requested Mr. Pond and Dr. Brinkley to observe the rates of their clocks, when the barometer was at its maximum and minimum height; and he learned with great surprise, that no variation could be observed.

Upon reconsidering the subject, however, it occurred to Mr. D. Gilbert, that the acceleration of the time of vibration produced indirectly by an increased resistance, in consequence of reducing the arc of vibration, and the circular excess, might be a perceptible quantity. This had not escaped Mr. Gilbert's notice, but he had regarded it as comparatively an evanescent quantity. When submitting it to calculation, however, he found that it was nearly equal to that of retardation arising from buoyancy, so that in a brass pendulum (Spec. Grav. 8. 8) with an arc of vibration of 3° 53′ 10″ and in a mercurial pendulum with an arc of vibration of 3° 3′ 28″, *the retardation from buoyancy is exactly compensated by the acceleration arising from the reduction of the circular excess.*

Hence, if in every clock, the arc of vibration is so adjusted as to make the retardation from buoyancy equal to the retardation caused by the circular excess, and if the density and consequent resistance of the medium be supposed to change, the incremental variations of the times arising from these two causes will be equal and in opposite directions.

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IMPROVEMENTS IN GLASGOW.

GENTLEMEN,—Our dumb admiration of your useful Magazine we have, we think, indulged sufficiently long; such conduct only betrays ignorance. Under leave of you therefore we will break silence, and "laud that all may hear."

In front of the Bucks-head Inn stands—as every citizen may know—a collateral protuberance in the shape of an out stair, or ascent. This indefinable turret juts so unphilosophically far into the street, that it becomes really a nuisance; nay, I had almost said, a drawback upon the commercial interest of the entire *south side* of Argyle Street: the pavement in the place in question becomes an isthmus so narrow; while passengers are so frequent, that it affords a scene of incessant elbowing, and struggling! This fact the inhabitants know well, and therefore dread and shun the spot as they would a very *Scylla.*

In brief, gentlemen, we, for our own part, think your city might do worse than purchase the Bucks-head, and supplant it. A much superior fabric might be expected to emerge from its ruins. Fancy finds no difficulty in already converting it into *eight* excellent shops, 4 to Dunlop Street, 3 to Argyle Street, and 1 to Wilson's court; yielding each at an average £70. per annum, together with 3 good flats averaging £60. £720. The magistrates are empowered to improve the city, why not act up to their power? The nuisance complained of should seem aukward in any city—in Glasgow, how inconsistent! in Argyle Street of Glasgow, shocking! For our own part gentlemen, believe us, we are no mason, therefore to get a *job* cannot be our motive, so much as the improvement of your city

L. M'L.

Island of Coll, April 20th, 1826.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, Teacher of Mathematics, Glasgow.

No. IV.—GEOMETRY.

Geometry is the science or doctrine of local extension, as of lines, surfaces, or solids. Different origins, more or less ancient, have been ascribed to Geometry; but there is reason to believe that Geometry, as well as most other sciences, was first cultivated in Egypt, and according to some authors, (as Herodotus one of the most ancient), it had its origin in the necessity there was of assigning to the inhabitants every year their particular shares of land; for as the country was annually overflowed by the Nile, it has been supposed that the land marks would be obliterated, and the possessions rendered undistinguishable from one another. Such is said to have been the origin of land measuring, the form under which Geometry was first known, and from which it has taken its name, for Geometry literally signifies, *the measuring of the earth*. But it may be remarked, that Geometry must have been cultivated previous to the time at which it was applied to this purpose, which supposes considerable advancement in the Science.

The commencement of the science must therefore be placed before this time, which according to Herodotus would be only about a thousand years before our era. If we were to indulge in frivolous distinctions, we would say that its origin was co-eval with the commencement of society, and that the invention was prompted by necessity, without the aid of any theory, for the purpose of constructing huts or houses. Confining ourselves, however, to the time when it assumes, at least to *our knowledge*, the character of a *real science*, we shall at once transport ourselves to the age of Thales.

From Egypt Geometry was carried unto Greece by Thales of Miletus. A. C. 640. This philosopher is said to have made numerous discoveries in Geometry; to him is ascribed the first employment of the circumference of a circle for the measure of angles, and he is said to have discovered that the angle in a semicircle is a right angle, an important discovery, which gave him great joy, and for which he is said to have thanked the muses by a sacrifice; it has been also said that he taught the Egyptians the method of measuring the heights of the pyramids at Memphis by the length of their shadows, compared with the length of the shadow of his staff. No doubt he made other discoveries in Geometry, which have been confounded among them, which have been collected and transmitted to posterity by the authors of elementary works.

Among the disciples of Thales were Anaximander and Anaxagoras; The first of these composed an elementary treatise on Geometry, the earliest mentioned in history; and the last is said to have attempted the quadrature of the circle, or in other words, to determine the length of the circumference compared with the diameter, a problem which has exercised the ingenuity and baffled the skill of mathematicians in every age; and they can only solve the problem by an approximation.

The name of Pythagoras is rendered immortal in the annals of Geometry, by the discovery which he made, that in every right angled triangle the square of the hypothenuse, or longest side is equal to the sum of the squares of the other two. A. C. 590. Some authors relate tha he was so transported with gratitude to the gods, for having favoured him with this discovery, that he sacrificed to them an hundred oxen, but we can scarcely reconcile this report with the philosophers moderate fortune, nor with his religious opinions concerning the transmigration of souls. Be this as it may, the Pythagorean problem ranks in the first class of Geometrical truths, both from the singularity of its results, and the number and importance of the cases to which it is applicable, in every branch of mathematics.

One of the most ancient of the Geometricians mentioned after Pythagoras is Œnopidus of Chio, who was the author of some very simple propositions, as of letting fall a perpendicular upon a right line from a given point, making an angle equal to another angle, and bisecting an angle, &c. A. C. 480. Zenodorus, his contemporary, and the first of the ancients of whose Geometrical writings any have reached us, a part of them being preserved by Theon in his comentary on Ptolemy. He showed the falsity of the opinions then entertained, that figures of equal circumferences, must have equal areas. The demonstration of this was not easy to discover, and proves that Geometry had then made considerable progress. The ingenious theory of the regular bodies originated about the same time in the Pythagorean school.

Hippocrates of Chios distinguished himself by the quadrature of the famous lunulae of the circle, which bear his name. A. C. 450. Thus having described three semicircles on the three sides of a right angled isosceles triangle, that on the hypothenuse being in the same direction as the others, he found that the sum of the two equal lines was equal to the area of the triangle.

This is the first instance of a curvilinear space being found equal to a rectilinear.—The attainments of Hippocrates in Geometry were very extensive. He wrote elements of Geometry much esteemed in his time, though other works of the kind particularly Euclids have caused his to be lost and forgotten. He appeared with honour in the list of Geometricians who attempted to solve the celebrated problem of the duplication of the cube, which at that time began to be pursued with ardour.

The object of this problem was to find a cube which should be double of a given cube, not in respect of its sides or superficies, but in its solidity, so that its weight should be double that of the other, supposing them both to be made of one homogeneal substance.—And it was to be resolved without employing any instruments beside the rule and compasses: for by the ancients no operation was considered as *Geometrical*, unless performed by means of these two instruments alone; those that required others being called *Mechanical.*

Acording to an old tradition generally spread through Greece, a public calamity gave rise to this research. It is said that Apollo having afflicted the Athenians with a dreadful pestilence to revenge an affront which he had received from that thoughtless sinful people, the oracle of Delphos, being consulted on the means of appeasing his godship's wrath, answered *Double the Altar.* The altar of Apollo at Athens to which the oracle alluded was a perfect cube; and the problem was immediately proposed to all the Geometricians of Greece. The difficulty was not increased by a condition annexed to the priests, that the altar should be of gold. The question at first sight appeared easy, but this was a mistake which was soon corrected; and the sagacity of all the Grecian mathematicians was baffled by it.

On considering the problem, Hypocrates discovered that if two Geometrical mean proportionals could be inserted between the side of the given cube, and the double of this side, the first of these two means would be the side of the cube sought. This new point of view revived, for a moment, the hope of accomplishing the solution by means of the rule and compasses, but the difficulty only changed its form, and it was still insurmountable; the Geometricians, tired with the labour they had already bestowed on the problem, let it rest for a time. If the Athenian plague had continued till the Dellian problem had been solved, by the methods which the ancient Geometricians would only admit, Athens would have been subjected to a never ceasing vengeance.

Still, however, Geometry advanced. A. C. 390. Plato cultivated it with care, and acquired profound knowledge in the science. We have no work of his expressly on the subject; but the ancient historians have transmitted to us the results of several discoveries with which he enriched it. He placed it in the highest rank of mental acquirements, and made it the principal object of the instructions he gave his scholars: over the door of his school was written, "Let no one enter here who is ignorant of Geometry." The problem of doubling the cube could not fail of engaging his attention. He invented, for the purpose of finding two mean proportions, an instrument composed of two rules, one of which moved in the groves of two arms at right angles with the other, so as always to continue parallel with it. But this solution was of the mechanical kind and did not satisfy the wish of Geometricians.

He was more fortunate in another speculation of a kind entirely new. Before his time the circle was the only curve considered in Geometry: he introduced into it the theory of the conic sections, or those curves which are formed in the surface of a cone, when cut by a plane in different directions. On attentively examining the generation of these curves, he discovered several of their properties, and the first notions being spread through his school, germinated rapidly. His principal scholars, Aristeus, Eudoxus, Menechmus, Dinestrates eagerly followed this branch of Geometry. In a short time it was so, extended as to form a distinct part of the science of a more exalted order than the common Geometry, when it derived the name of the higher or sublime Geometry and afterwards some other curves were comprised under the same denomination.

Aristeus composed five books on conic sections of which the ancients have spoken with praise, but unfortunately they have not reached us. A. C. 380. Menechmus applied them in two different methods to the solution of the problem of doubling the cube. And it appears, that if we possessed the means of describing the conic sections by one continued motion, and in as simple a manner as we can trace a circle with the compasses, the solutions of Menechmus would have all the advantages of Geometrical constructions, in the sense in which the ancients understood the term; but there exists no instrument for this purpose.

The problem of the trisection of an angle, which is of the same nature with doubling the cube, was equally agitated in the school of Plato. Its solution could not be attained by the rule and compasses, but the conic sections were applied to this problem likewise.

According to the modern methods, each of these problems leads to an equation of the third order, with this difference, that the equation relative to the duplication of the cube has but one real root, while that relating to the trisection of an angle has three.

Though the ancient Geometricians did not attain their principal objects, their researches were useful in other respects: Geometry is indebted to them for several new theories, and there is reason to suppose that those of the conic sections and of Geometrical loci, originated from the attempts of the Geometers of the Platonic school to solve these two celebrated problems.

MISCELLANIES.

Population.—In Great Britain the number of individuals in a state to bear arms, from the age of 15 to 60 is, 2,744, 847 The number of marriages is about 98,030 yearly; and it has been remarked that in 63 of these unions there were only 3 which had no issue. The number of deaths are about 332,708 yearly, which makes nearly 25,592 monthly, 6388 weekly, 914 daily, and 40 hourly. The number of deaths among the women are in proportion to those of the men as 50 to 54. The married women live longer than those who continue in celibacy. In the country, the mean term of the number of children produced by each marriage is 4; in town the proportion is 7 for every 2 marriages. The number of married women is to the general number of individuals of the sex as 1 to 3; and the number of married men to all the individuals of the male sex as 3 to 5. The number of widows is to that of widowers as 3 to 1; but the number of widows who marry again, is to that of widowers in the same case as 7 to 4. The individuals who inhabit elevated situations live longer than those who reside in less elevated places. The half of the individuals die before obtaining the age of 17 years. The number of twins is to that of ordinary births as 1 to 65. According to calculations founded upon the bills of mortality one individual only in 3126 attains the age of 100 years. The number of births of the male sex is to that of the female sex as 96 to 95.

Local Attractions.—The connaissance des temps. 1827 contains an account of geodetical operations in Italy by the French geographical engineers, remarkable for the discordance it exhibits between results deduced from these operations, and from astronomical observations. Of the exactness of the survey no doubt canbe entertained from the recital given, and the astronomical results are founded on the observations of several most able astronomers. The discordances, which in one case amount to nearly 27″ and in another to 17″ are attributed to local deviations of the plumb line, caused by irregular attractions. The matter near the surface at Milan appears to attract the plumb-line considerably to the north of the vertical, and that near Remini considerably to the south.—*Dublin Phil. Tour.*

New method of preparing Quills.—The following is the manner in which M. Scholz of Vienna proceeds in the preparation of quills for writing, by means of which he renders them more durable, and even superior to the best Hamburgh quills. For this purpose he makes use of a kettle, into which he pours common water, so as to occupy the fourth part of its capacity, he then suspends a certain quantity of feathers perpendicularly, the barrel lowermost, and so placed, as that its extremity may only touch the surface of the water; he then covers the kettle with a lid properly adjusted, boils the water, and keeps the feathers four hours in this vapour bath. By means of this process he frees them of their fatty parts, and renders them soft and transparent. On the following day, after having scraped them with the blade of a knife, and then rubbed them with a bit of cloth he exposes them to a moderate heat, by the day after they are perfectly hard and transparent, without however having the inconvenience of splitting too easily.

Method of using pure Muriate and Sulphate of Soda in the Manufacture of Glass, by M. Lequay.—Muriate of soda and sulphate of soda may be employed, and at times with advantage in glass making. A casting is readily obtained of very fine glass, having, when about three or four lines in thickness a very slight green tinge. The composition is as follows:—decrepitated muriate of soda 100 parts; sand 140; clippings of glass of the same quality from 50 to 200 parts. Sulphate of soda likewise offers a great economy in its employment. The results are very satisfactory. The glasses made with this salt were of a very fine quality. The following is the composition: dry sulphate of soda 100 parts; slaked lime 12; powdered charcoal 19; sand 225; broken glass from 50 to 200. These proportions give a rich coloured glass, which may be employed with advantage in glass houses, where a fine quality is sought after. The following is the second way of operating with sulphate of soda; the proportions may be as follows: dry sulphate of soda 100 parts; slaked lime 266; sand 500; broken glass from 50 to 200. According to this process it is obviously easy to operate in a regular manner, and to avoid expensive trials in the manufacture.

USEFUL RECEIPTS.

Permanent Ink for marking linen.—Mix together in a phial 100 grains of lunar caustic, two drachms of gum arabic, one scruple of sap green, and one ounce of rain water.—The cloth to be marked must first be wetted with the following liquid, and suffered to get quite dry before writing on it. One ounce of sal soda, dissolved in two ounces of rain water, when the articles are marked they should be exposed to the sun, which will turn the writing quite black.

Red marking Ink.—Vermillion half an ounce, sal of steel one drachm, finely levigated with linseed oil to a proper consistency.

Method of cleaning and polishing steel.—After well oiling the rusty parts of the steel, let it remain two or three days in that state; then wipe it dry with clean rags, and polish with emery or pumice stone, on hard wood. Frequently however, a little unslacked lime finely, powdered will be sufficient, after the oil is cleared off. Where a very high degree of polish is requisite, it will be most effectually obtained by using a paste composed of finely levigated blood stone and spirits of wine. Bright bars are, however, admirably cleaned in a few minutes, by using a small portion of corn emery, and afterwards finishing with flour of emery or rotten stone; all of which may be obtained at any ironmonger's or oil shop. This last very simple method will render any other superfluous.

To remove spots of grease, pitch, or oil from woollen cloth.—In a pint of spring water dissolve an ounce of pure pearl ash, adding to the solution a lemon cut in small slices. This being properly mixed and kept in a warm state for two days, the whole must be strained and kept in a bottle for use. A little of this liquid being poured on the stained part, is said instantaneously to remove all spots of grease, pitch or oil, and the moment they disappear, the cloth is to be washed in clear water.

Preparation of Printer's Ink.—Put a quantity of nut or linseed oil into an iron pot, so as to half fill it; make it boil for some time, then set it on fire, and when it has burned for half an hour, put out the flame, and let it boil gently till it acquires a proper consistency. It is then to be removed from the fire, and when cold, ground with lamp black in the proportion of two ounces and a half, to sixteen ounces of oil. Vermillion or Prussian blue is used for inks of those colours.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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> " Instead of glorious feats achieved in arms,
> Bid rising arts display their mimic charms."—*Warton.*

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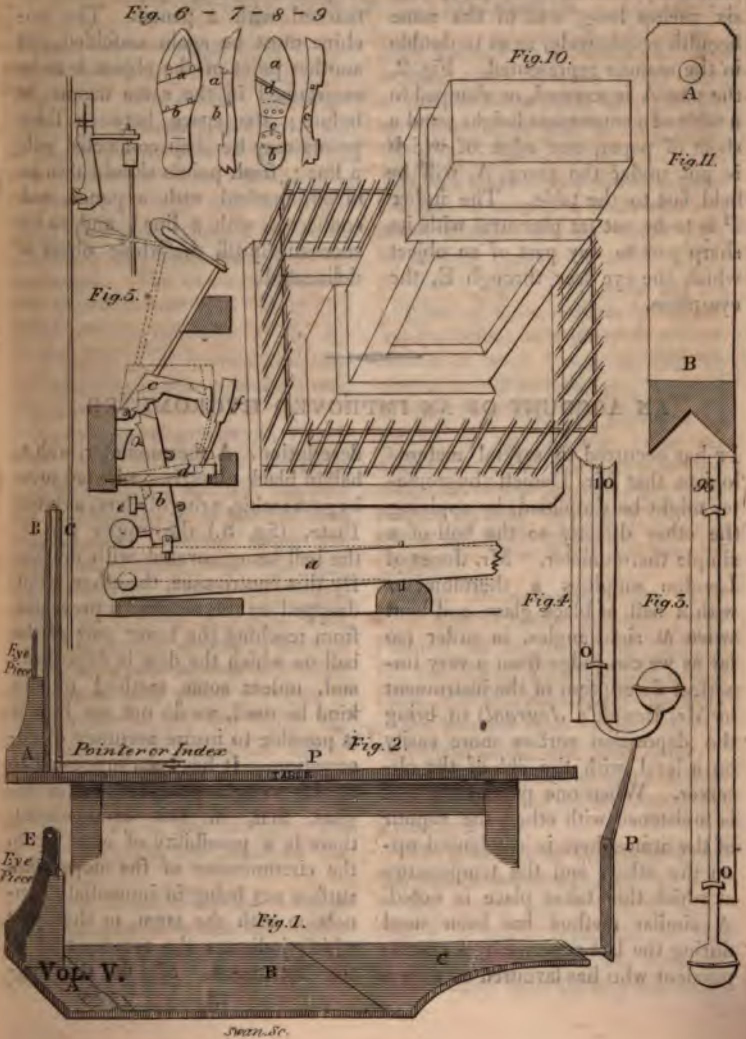
INSTRUMENT FOR DRAWING IN PERSPECTIVE; IMPROVED HYGROMETER, &c. &c.



DESCRIPTION OF A CHEAP, SIMPLE, AND PORTABLE INSTRUMENT, FOR DETERMINING THE POSITION OF OBJECTS IN TAKING A PICTURE FROM NATURE.

By R. L. Edgeworth, Esq.

Various contrivances have, from time to time, been employed to facilitate drawing in perspective. The following one is simple, cheap, and portable.

A, B, C, (fig. 1,) represent three mahogany boards, two, four, and six inches long, and of the same breadth respectively, so as to double in the manner represented. Fig. 2, the part A is screwed, or clamped to a table of a convenient height; and a sheet of paper, one edge of which is put under the piece A, will be held fast to the table. The index P is to be set (at pleasure) with its sharp part to any part of an object which the eye sees through E, the eye-piece.

The machine is now to be doubled as in fig. 2, taking care that the index is not disturbed; the point, which was before perpendicular, will then approach the paper horizontally, and the place to which it points on the paper must be marked with a pencil. The machine must be again unfolded, and another point of the object is to be ascertained in the same manner as before; the space between these points may be then connected with a line; fresh points should then be taken, marked with a pencil, and connected with a line; and so on successively till the whole object is delineated.

AN ACCOUNT OF AN IMPROVED HYGROMETER.

It has occurred to several meterologists, that Mr. Daniell's hygrometer might be simplified, by applying the ether directly to the ball of a simple thermometer. Mr. Jones of London employs a thermometer with a ball of black glass, and bent twice at right angles, in order (so far as we can judge from a very imperfect description of the instrument in Mr. Brande's *Journal*) to bring the deposition surface more easily on a level with the eye of the observer. When one part of the ball is moistened with ether, the vapour of the atmosphere is condensed upon the other, and the temperature at which this takes place is noted. A similar method has been used during the last summer by a correspondent who has favoured us with a description. A thermometer, with a ball of black glass, has adapted to it, by gum arabic, a ring of silver, as in the Plate, (fig, 3.) the upper part of the ball being covered with muslin. By this contrivance, the ether, when dropped on the muslin, is prevented from reaching the lower part of the ball on which the dew is deposited; and, unless some method of this kind be used, we do not see how it is possible to insure accuracy of observation. It has been suggested to us by several practical meteorologists, that, in this arrangement, there is a possibility of error from the circumstance of the deposition surface not being in immediate connection with the stem, or that part which indicates the temperature of the instrument. Should this suggestion be found correct, it will be necessary to employ a thermometer, bent as in the Plate, (fig. 4.) If the ether be dropped on the upper part of the ball *a* the vapour is condensed upon the lower portion, which is the part that gives the temperature of deposition, and every chance of error is avoided.—*Edin. Jour. of Science.*

PATENT TO HENRY SMART,

OF BERNER'S STREET, IN THE PARISH OF MARY-LE-BONE, IN THE COUNTY OF MIDDLESEX, PIANO-FORTE MANUFACTURER,

FOR HIS INVENTION OF CERTAIN IMPROVEMENTS IN CONSTRUCTION OF PIANO-FORTES.

THESE improvements apply to upright piano-fortes, and consist in an improved mechanism connected with the hammers, and with the keys, for the purpose of preventing the hammers from rebounding against the strings, and also shortening the action when a quick repetition of the same note is to be performed. The mode of effecting this object cannot well be understood without reference to the representation of the hammer, the key, and appendages shewn in the Plate, (fig. 5.)

Every key of an upright piano-forte, upon this improved principle, is to be furnished with the mechanism here shewn; *a* is the key supported, and vibrating upon the centre rail, as usual, with a pin passing through it. At the hinder part of the key a small stapple is fixed, which carries the lever *b*; the top of this lever acts against the block *c*, or piece into which the stem of the hammer is set, and hence the depression of the key at one end by the finger of the performer, causes it to rise at the reverse end, throwing up the lever, and impelling the hammer against the string of the instrument.

This is stated to be the common construction of a certain description of upright piano-fortes called the grasshopper action. The improved parts are now to be described; *d* is a small piece of wood rising upon a sort of hinge-joint, and through an oblong hole slit, in this piece, the lever *b* passes freely. In order that this piece *d* may rise whenever the key is struck, a small stud *e* is inserted into the lever, which stud, by striking against the under side of *d*, lifts it up. This stud, for the purpose of more accurately adjusting its action, is made with an eccentric or snail head, so that by turning round its screw pin, the edge of the stud may be placed at a greater or less distance from the underside of the piece *d*, and consequently when in action will raise it more or less, as may have been found necessary in the previous adjustment.

Near the extremity of the piece *d*, a wire is introduced with a pad *f* at top, for the purpose of catching the tail part of the block *c* as it falls back, thereby preventing the stem of the hammer from striking against its rest as usual, and from which it frequently rebounds, giving a second blow to the string, so as to produce a jarring sound.

The positions of the parts when the note is struck are shewn by dots in the figure, and it will be seen, that if a quick repetition of the same note is required, the pressure of the finger upon the key will cause the notch or shoulder of the lever *b* to lift the block *c*, and give the note instantly, as the hammer now standing so near to the string does not require that time to perform its action which it would do if it had fallen back upon its rest. Releasing of the key however by the removal of the finger, permits the parts to return slowly to their quiescent state, and the hammer to fall back upon its rest.

There are many parts of this mechanism which are not new, and are therefore not claimed under this patent; the improvements being limited to the piece *d*, with its adjustable lifting stud *e*, the catch *f*, and the tail part of the block *c*, in which the stem of the hammer is fixed. The moving parts are all counter-balanced with weights as usual, in order that they may fall into their proper positions by their own gravity, and the surfaces which come in contact are all covered with soft leather, to prevent the rattling noise which they would otherwise produce when in action.

PATENT TO JAMES HOLLAND,

OF FENCE HOUSE IN THE PARISH OF ASTON IN THE COUNTY OF YORK, SHOE-MAKER,

FOR HIS INVENTION OF CERTAIN IMPROVEMENTS IN THE MANUFACTURE OF BOOTS AND SHOES.

THE improvements herein proposed consist in making the soles of boots and shoes principally of wood, with hinge joints, the leather of the welts being folded over the edges of these wooden soles, and made fast by nails or screws. The particular construction of these soles, are shewn in the Plate. Fig. 6. represents the under side of a sole suited to a man's boot, and fig. 7. is a section of the same; there are hinge joints at *a* and *b*, for the purpose of giving flexibility, that the sole may bend and accommodate itself to the motion and foot of the wearer.

The sole may be made of any suitable light wood: that which is least likely to split is to be preferred. The wood is to be boiled in lime water, and when it has become dry it is to be soaked in oil. The inside of the sole may be covered with a piece of cloth steeped in tar, to render it impervious to water. The upper leather and other parts of the boot are to be made by sewing, in the same way as usual, and the edges of the leather turned over the bevel edges of the sole, and made fast thereto by nails or screws, as above said. The boot being thus made, suitable iron tips are to be attached to the toe and heel, when it is to be considered finished.

A differently constructed sole is proposed for shoes similar to that shewn at fig. 8. of which fig. 9. is a section. The toe part *a*, is of wood, so also is the heel part *b*, but the middle or small part *c*, is to be of leather. A hinge joint is to be formed at *d*, for the purpose of affording play to the toe part of the shoe in walking, and the thick substance of leather in the small of the foot (attached to the wood by screws or rivets) is to afford the necessary elasticity. The upper leather, quarters, and welt, are to be made as usual, by stitching with wax-ends, but the leather is to be brought over the edges of the sole, and made fast as before described, by small nails or conical wood screws.

These boots and shoes are stated to be twice as durable as those commonly made with leather soles: are capable of being finished with equal smartness, and are not in any degree inconvenient to the wearer.

THE HORIZONTORIUM.

As the effect of this optical illusion entirely depends on correctly placing the sight piece, a piece of card for that purpose must be cut out of the exact size and shape of A. B. (fig. 10.)

An aperture for the eye, about the size of a small pea, must be made precisely at the spot shewn at A: and the shaded part at B must be folded back at a right anglo, so as to form a kind of foot to stand upon.

The sight piece must then be placed perpendicularly, when by keeping the subject, for instance that represented in fig. 9, perfectly horizontal, and placing the eye close to the aperture A, there will be seen a perfect representation of a tombstone inclosed by palisadoes.

VIVISECTION.—By Mr. Maclure.

Read before the Glasgow Philosophical Society, 1st May, 1826.

[The following are extracts from a Memoir lately read before the Philosophical Society by the above mentioned gentleman, and as it contains rather a novel view of the interesting subject of which it treats, we have requested him to permit us to lay it before our readers, which he has obligingly consented to.—*Eds.*]

* * * In all the discussions which have taken place on the subject of cruelty to animals, a *lunge* has been aimed at the physiologist for his share in the delict; although it is quite certain, that any accuracy or beauty as a science, which medicine can at present boast of, and most of the triumphs of modern surgery, have been achieved principally by the aid of this very practice. The circulation of the blood—the existence and function of the lacteals—our only accurate notions with respect to the nervous system—the theory of the union of fractured bones—of the closure of tied arteries—of the action and cure of poisons, &c. &c. have all been discovered and illustrated by experimenting upon living animals. The very nature of things indeed prevents the dissection of the *dead* body from supplying almost any information upon these and many other highly important topics. No wonder then that many have been a good deal surprised to observe that the magnates of our own profession in this country, men who have risen to their present elevation upon the credit of their discoveries, effected mainly by their genius in devising, and dexterity in performing a multitude of experiments upon living animals, have combined to swell the cry against the illustrious *Magendie*, and lent the authority of their names to deter the rising generation of physiologists from following in his and their own brilliant paths, and ultimately enlarging and perfecting (perhaps overturn-

ing!) those discoveries upon which their present emoluments and hopes of future glory are founded. But to pass over this very obvious and glaring inconsistency, I would beg leave to turn the attention of the Society to a view of the subject which, I believe, has not hitherto been taken; but which, I think, with all reasonably persons, must take away considerably from the horror with which the ignorant and pseudo-benevolent regard the laudable (because useful) instrument of discovery, which is at present under our review.

In all the debates in Parliament, and the declamations out of it, which have been published on this subject, a principle has always been taken for granted, which first ought to have been proved, namely, that these experiments really do occasion a very high degree of pain to the *unforeseeing* and *unreflecting* creatures on which they are performed. Mr. Martin, Dr. Chalmers and others, place *themselves*, with all their powers of foresight and reflection, in the situation of these animals, and then hastily infer that the latter must suffer as much pain as they would do in the same or similar circumstances. But this is by no means the fact It is the memory of the past and the prescience of the future which form the two edges of *human* anguish; but what Burns truly and beautifully says to the desolate mouse may, with equal propriety, perhaps, be said to the whole inferior creation,

"The *present* only toucheth thee;"

and all the suffering which, by any ingenuity or malignity, can be accumulated upon an animal whose faculties are mercifully bounded to the contemplation of the *present*, and that present a fleeting *instant*, can never be very great. Let us take a familiar example. A turkey, which is usually killed by opening a blood-vessel above the ear, and allowing it to bleed to death, feels no more pain during the infliction of its death-wound than a person does who undergoes the operation of blood-letting, which, we all know, is very trifling, and even that is over in an instant. And as the animal does not foresee, it can have no horror of the object of the process, as Mr. Martin in similar circumstances would have; and by the time the shades of death prevail, the detraction of blood (the *stimulus* which gives all keenness to the sentient system) has been so great that all sensibility is gone, and the unconscious animal dies long before inflammation can have come on, in a complete state of coma.

But, further, granting even that animals really do suffer as much under the scalpel of the experimentalist as a man would do in the same circumstances, I would still maintain that such pain is, by no means, so exquisite as is commonly imagined. It is well known to anatomists, that the sensibility of men, as well as of inferior animals, like the heat of flame, is nearly all accumulated upon the surface; and as gunpowder may be placed in the *central* parts of flame without an explosion, so the *internal* parts of animal bodies may be handled, and even cut into, without occasioning much of painful feeling. The deep-seated parts and all the vital organs, have but a scanty supply of the nervous filaments whose function is to convey sensation to the brain. They do not need it. Once past the skin, which is soon done, and you may penetrate the liver, handle the bowels, pierce the eye, stab the heart, and even take a slice off the brain without causing much of pain. We observe in amputating a limb, that the skin has the keenest degree of sensibility, the cellular substance the next, that of the muscles diminishes as you go inwards, and the bones, in a healthy state, have none at all. This is a wise and most beautiful provision of nature, directed against injuries, and intended to fortify the self-conservative principle of animals, inasmuch as injuries are commonly inflicted upon the surface, and being most sensible, it will be best taken care of; but who does not see that the same beneficent provision also tends to justify the experiments of physiology, since they are generally performed upon the internal and impassive structures of animals?

This argument, while it goes far to exculpate the physiologist, obviously ought to strengthen the hands of Mr. Martin in his laudable efforts to repress the brutalizing sports of the great and little vulgar, since the injuries inflicted in these pastimes are uniformly suffered by the superficial and most sentient parts of animals.

Passing over then the obvious argument derived from its utility, our apology for vivisection is founded upon these two principles, viz.

1. That brutes, not being endowed with the powers of reflection and foresight, and only being conscious of the pain of the present moment, really do suffer very little under the scalpel.

2. That even supposing (which is not the case) that they do suffer as much as men would do in similar circumstances, such suffering, from the known constitution of all animal bodies, can never be very great.

And from these premises, I think, I am entitled to conclude, that since the operations of the experimentalist are principally carried on among the deep-seated and least sensible parts of living animals, and since it may be entrusted to men of science, and presumably of feeling, that they will inflict no pain which is not absolutely necessary to the success of their experiments, the Legislature will, perhaps, do wisely to let them alone, and concern itself only with objects more within the sphere of its knowledge and useful activity.

* * * * * * * *

The use of narcotics to blunt the feeling of pain during surgical operations on the human body has had advocates in every age, and the proposition has lately been revived. Many grave objections may be suggested against this practice; but, I imagine, the proposal may, with propriety, be entertained, if made with a view to obtund sensation in inferior animals, when about to undergo suffering for the benefit of science and the prospective good of man. It is true, that vivacity of feeling, and the power of exhibiting the signs of lively sensation, are necessary to the success of many of these experiments; in such, therefore, the employment of narcotics must necessarily be excluded. But there are many experiments made upon living creatures in which a bluntness of feeling produced by such drugs would not disturb the results in any material degree—and in such it might be well for the humane experimentalist, with all his knowledge of the parts on which he operates, to consider how far the maxim of Holy writ, that "a righteous man is merciful to his beast," is or is not applicable, even to the man of science, who is engaged in the noble pursuit of enlarging the boundaries and extending the usefulness of THE HEALING ART.

CONSUMPTION OF FOOD IN PARIS FOR 1824.

BEVERAGES.	Wine,	hectolitres,	967,465	25559457.8 galls.
	Spirits,	"	53,314	140852.5 "
	Cider and Perry,	"	12,023	317635.6 "
	Vinegar,	"	19,383	512079.5 "
	Beer,	"	154,405	4079225.7 "
	Raisins,	half-kilogrammes,	2,344,360	2587001.2 lbs.
EATABLES.	Oxen,		79,627	
	Cows,		10,941	
	Calves,		76,811	
	Sheep,		383,807	
	Pigs and Boars,		89,110	
	Viande à la main	kilogrammes,	1,397,452	3084176.5 lbs.
	Offal, &c.		714,069	1575950.3 "
	Cheese,		1,451,032	3202427.6 "
	Fresh sea fish,	kilogrammes,	4,110,008	9070787.6 "
	Oysters,	francs,	1,013,608	
	Fresh water fish,	"	633,082	
	Poultry and game	"	8,701,510	
	Butter,	"	4,573,061	
	Eggs,	"	4,230,942	
	Hay,	trusses,	9,231,590	
	Straw,	"	15,077,840	
	Corn,	hectolitres,	1,181,007	31201024 galls.

The corn and flour sold at the market place is not included in this table, inasmuch as these sales do not give the real consumption of the town: it is estimated at 1500 sacks of the weight of 159 kilogrammes each per day.

When the price of bread is higher out of Paris than in the town, then nothing is brought in; but on the contrary, food is taken out: the daily consumption has no rule, and at times is above 1700 sacks.—*Ann. de Chimie xxx.* 440.

SINGULAR OPTICAL ILLUSION SEEN THROUGH A TELESCOPE.

If we direct a telescope to the surface of a distant field on which there are no objects, such as trees, houses, &c. and if the field of the telescope embraces nothing but the surface of the field, the eye will speedily recognize that the field is horizontal or slightly inclined to the horizon, from the perspective of the furrows or drills upon its surface, or even from its aerial perspective, provided the difference in the distances of the nearer and the remoter end is considerable, and the air sufficiently hazy.

The field, however, may be so situated, and have such an inclination, that, when seen through the telescope, it appears like a perpendicular or *vertical wall of earth*. This phenomenon we have often seen in directing a telescope to a field above Melrose Abbey on the northern acclivity of the north-west Eildon

Hill. This field is capable of being ploughed in the direction of its greatest declivity; but when it is viewed through a telescope, the slope is such that the furrows do not appear to converge, and the eye cannot readily perceive any difference between the breadth of the furrows at the remote end of the field, and their breadth at the near end. The observer, therefore, immediately concludes that the field must be nearly a vertical plain rising in front of him. This disception is a very remarkable one, and produces a singular effect on the mind when the field is covered with a crop, and when crows, &c. light upon it. I have not yet observed the effect produced when it is in the act of being ploughed. It is very probable that the impossibility of ploughing a vertical plain may remove the deception.

NEW WEIGHTS AND MEASURES.

TO THE HON. MUNGO NUTTER CAMPBELL, Esq. LORD PROVOST OF GLASGOW.

My Lord,

In requesting from your Committee on Weights and Measures, "An opinion respecting the attacks made in the Glasgow Chronicle upon that part of their report which regards the heaped measures," the Magistrates of Glasgow have shewn an anxiety to satisfy the public mind, highly creditable to their feelings. I trust, therefore, that the following respectful attempt to place in a clear light the above subject of dispute will meet with a moment of your Lordship's attention. I have not read the Chronicle censures, nor do I mean to disturb my own peace of mind, or my neighbour's, by controversial criticism.

That the Act of Parliament is not sufficiently explicit in reference to heaped measures, is evident from the circumstance of Dr. Wollaston being called upon by the Lords Commissioners of the Treasury, to expound it. This most acute and accurate philosopher accordingly furnished the following series of dimensions, which were to define the diameters of the bases of the conical heaps, as well as the outside diameters of the successive cylindrical measures.

Bushel,	19½	inches.
Half-Bushel,	15½	"
1-Fourth Bushel or Peck,	12¼	"
Half-Peck,	9¾	"
Half-Gallon,	7¾	"
Quart,	6⅛	"

The *height* of the Bushel cone is required by the Act to be 6 *inches, at the least.* The inside diameters of the cylindrical dry measures must be, *at the least,* double the depth thereof; and the height of the cone or heap, must be equal to three-fourths of the depth of the said measure, the outside of the measure being the extremity of the base of such cone. If we take the height of the bushel cone, at 6 inches, as the Act seems to point to, and as your Committee has adopted, then the subdivision measures are linked together in a regular and beautiful chain of dimensions.

1. A cone 6 inches high, the circle of whose base has a diameter of $19\frac{1}{2}$ inches, has a capacity of 597.306 cubic inches, or very nearly 600. If the axis of the cone be 6 inches, the cylinder beneath it must be 8 inches deep, agreeably to the parliamentary proportions of 3 to 4. Now, a cylindrical vessel 8 inches deep, must have an inside diameter of 18.7893 inches, in order that it may contain 2218.192 cubic inches = an imperial bushel; deducting 18.7893 from 19.5 inches, the difference 0.7107, divided by 2 gives 0.35 or about $\frac{3}{8}$ of an inch, for the thickness of the sides of the bushel vessel, or at least for the breadth of its lip or rim, on which the circumference of the heaped cone rests.

2. The conical heap over the half-bushel cylinder, must obviously contain one-half of the conical heap over the whole bushel cylinder, or $\frac{597.306}{2} = 298.653$ cubic inches. But as the diameter of its base is fixed by Dr. Wollaston at $15\frac{1}{2}$ inches, its height must inevitably be 4.74826 or $4\frac{3}{4}$ inches. Now, the depth of the half-bushel cylinder being to the axis of its conical heap as 4 to 3, that depth will be 6.33101 or $6\frac{1}{3}$ inches. Thus, the depth being defined, and the capacity being 1109.096 cubic inches = half an imperial bushel, its inside diameter is necessarily fixed at 14.935 inches, or very nearly $14\frac{15}{16}$ inches. If from the outside diameter 15.5, we deduct the inside diameter 14.935, half the difference, or $0.2825 = \frac{9}{32}$ of an inch, will be the thickness of the upper edge or lip of the half-bushel vessel.

3. The contents of the conical heap over the quarter bushel or Imperial Peck, are 149.326 cubic inches $= \frac{597.30}{4}$, or in practical numbers 150. A cone of this capacity, standing on a circular base of $12\frac{1}{4}$ inches diameter, must have a height of 3.8009 inches. 4-thirds of that height, or 5.0678, will therefore be the inside depth of the peck cylinder. And a cylinder whose capacity is an imperial peck = 554.548 cubic inches, and depth 5.0678 inches must have a diameter of 11.806 inches. Deducting this number from the above outside diameter, = $12\frac{1}{4}$ inches, the difference 0.444 divided by two, gives 0.222 or nearly 3-sixteenths of an inch for the thickness of this vessel or breadth of its rim or lip.

The arithmetical process of the above deduction, is perfectly simple and direct. It is to be regretted that your Committee on weights and measures should (as appears) have suffered themselves to be trammelled at the outset with the prejudices or habits of coopers, who would naturally tell them that cylindrical measures for potatos could not be made sufficiently strong and durable, unless a much greater thickness were given to their sides, than the above dimensions permit. Hence your bushel cylinder is ordered to be $\frac{3}{4}$ of an inch thick at the mouth, instead of $\frac{3}{8}$, and hence, its depth has been proportionally increased from 8 inches to 8.71694. Your Committee has moreover, violated with regard to the bushel measure, the general parlimentary ratio of 3 to 4, between the axis of its cone and cylinder, while they have adhered most scrupulously to that ratio in all the subdivision measures. This discrepancy was not forced upon them by the terms of the act, for it only declares that the height of the bushel's cone must be 6 *inches at least.* Your Committee, ought not, therefore, to have excluded the whole bushel, or primary measure, from the general system of proportions. Had they made the height of its cone 6.54 inches, or $\frac{3}{4}$ of 8.71694, then they neither would have disobeyed the spirit of the act, nor would they have committed the slight arithmetical error, about which a very superfluous noise has been made, for all the subdivision measures, as they are defined in their report, would thereby have been correct submultiples of the above bushel. The act of parliament, even as expounded by Dr. Wollaston is far too vague with regard to the conical heaps, permitting a very considerable latitude in their capacity to the extent of above 60 cubic inches. Thus let us take two cylindrical measures, in each of which the outside diameter is 19$\frac{1}{2}$ inches. In one let the inside diameter be 18 inches, and its depth 8.710694. Its streaked capacity will be exactly a bushel, or 2218.192 cubic inches; and that of the conical heap standing over it, to a height equal to $\frac{3}{4}$ of its depth, will be 654 cubic inches, very nearly. Now this vessel is perfectly conformable to both the Act and the Treasury instructions. Next, let the inside diameter of the other be 18.7893 inches (its thickness being $\frac{3}{8}$ of an inch) and its depth 8 inches. This cylinder streaked will contain exactly 2218.192 cubic inches. And the cone standing above it to a height = $\frac{3}{4}$ of its depth, or 6 inches will contain only 597.3 cubic inches. Now this measure is also strictly conformable to the act and the instructions, yet the former measure contains about 57 cubic inches more than the latter.

The diameter of the base of the bushel's cone, has been selected at 19$\frac{1}{2}$ inches, because this dimension introduces a curious and singular facility, into the arithmetical relations. Right cones standing on a circular base of this diameter, contain 100 cubic inches for every vertical inch of axis. Thus, such a cone whose axis is 2 inches and $\frac{3}{4}$ or 2.75 inches high, has a capacity of 275 cubic inches. And a cylinder 19$\frac{1}{2}$ inches diameter, has a capacity of nearly 300 cubic inches, for every vertical inch of axis.

Now, my Lord, as so much embarrassment seems to have arisen from the adjustment of cylindrical measures made of staves, why should not your Committee adopt at once vessels of cast iron. Their weight, will, I assure you, be very little greater than that of strong wooden vessels bound with iron hoops; when properly annealed, they are not brittle, but become soft enough to admit of being stamped with a dye; and, what is of much consequence, while they exclude the possibility of fraudulent diminution of their capacity, they are from 30 to 40 per cent. less costly than cooper's vessels. They will wear for any length of time, and if accidentally cracked, they may be clasped by any blacksmith for a trifle of expense. The city arms may be cast on each vessel, along with its title of bushel, peck &c. and its dimensions in depth and diameter. Were such correct and inflexible measures introduced by your Committee, Glasgow would possibly possess the most scientific, economical, and secure set of measures of any district in the kingdom.

The following table exhibits the dimensions of the measures, agreeably to Dr. Wollaston's views. Each measure should have a horizontal rim, lip, or bead of the proper breadth to circumscribe the base of the cone. This will also strengthen it at the weakest part.

Perhaps, your Lordship and some of the other gentlemen, who have taken an interest in the *new* weights and measures, will remember that the above plan was pressed upon your attention, before ever the Committee commenced its sittings.

	Inside Diameter,	Horizontal Rim,	Diam. over the Rim,	Depth,
1. Bushel, ———	18.7893 ($18\frac{13}{16}$)	0.35 ($\frac{3}{8}$)	$19\frac{1}{2}$	8.000
2. Half-Bushel,	14.935 ($14\frac{15}{16}$)	0.2825 ($\frac{9}{32}$)	$15\frac{1}{2}$	6.33101
3. Peck, ———	11.806	0.222 ($\frac{7}{32}$)	$12\frac{1}{4}$	5.0678
4. Gallon, ———	9.39463 ($9\frac{3}{8}$)	0.17768 ($\frac{3}{16}$)	$9\frac{3}{4}$	4.000
5. Half-Gallon,	7.46729 ($7\frac{1}{2}$)	0.1413 ($\frac{1}{8}$)	$7\frac{3}{4}$	3.16565
6. Quart, ———	5.90156 ($5\frac{9}{10}$)	0.111 ($\frac{1}{9}$)	$6\frac{1}{8}$	2.53411

I have the honour to be, with much esteem,

My Lord, your Lordship's most obedient servant,

CIVIS.

Glasgow, May 3d, 1826.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, Teacher of Mathematics, Glasgow.

No. V.—GEOMETRY.

In proportion as the science was extended, particular treatises appeared from time to time, in which the known propositions were collected and arranged in a systematic order. Such was the object of Euclid, a Geometrician of the Alexandrian school, in his celebrated *Elements.* A. C. 300. This work is divided into fifteen books, eleven of which belong to pure Geometry, the other four treat of proportions in general, and the principal properties of commensurate and incommensurate numbers. Though the theory of conic sections was considerably advanced in his time, he has not mentioned them, as his object then was simple elementary Geometry; but it appears by his data, and by some fragments of other works, that he was well versed in them. This work has had the singular good fortune to preserve its reputation in all ages and all countries where the science has been cultivated, and it has served as the ground work of innumerable other treatises, few of which if any have excelled it. Many commentaries have been written upon it, and it has been translated into almost all the European and Oriental languages.

Euclid likewise wrote several other works on Geometry, of these we have his data, which may be considered as a continuation of his elements, and we have an account of a work of his on Porisms, in the Mathematical collections of Pappus; but it has suffered so much from time as to be almost unintelligible. Through the course of ages, the works of the ancient Geometrician became corrupted by the alterations of ignorant editors; many of the moderns have laboured in clearing the elements of the imperfections thus accumulated; among these Dr. Simpson of Glasgow has given an edition of Euclid which as yet stands unrivalled in accuracy, and little has since been done in the improvement of the text of Euclid's elements. Dr. Simpson also bore a principal part in restoring the works of Euclid which had been lost, and it has been said that his restoration of the work only differs from the original by excelling it. Of this eccentric man, and truly great genius, an anecdote, for the authority of which I have little hesitation of pledging myself, was formerly commonly related in Glasgow. Before the publication of his edition of Euclid, he had solicited admission into the Royal Society of London, which, for some reason or other, had not been granted. When the work was published, he was offered the honour he had before requested, but the pride of the Doctor had been offended, and he declined the proferred honour. He said to some of his friends that the people were they to see F. R. S. after his name, would suppose that these letters, instead of shewing his fellowship with that honourable body, would only mean Foolish Robin Simpson.

Euclid has confined himself in his elements to the strict method sanctioned by the unanimous assent of the ancient Geometricians. But for this reason his demonstrations are sometimes long, indirect, complicated and difficult to be followed by beginners. This has induced several among the moderns, to employ more simple and easy demonstrations than the celebrated author. And to this inconvenience attached to the ancient methods, we must perhaps ascribe the difficulties which Ptolemy Philadelphusking of Egypt, in other respects a man of understanding, experienced in studying the mathematics; weary of extreme attention, he asked Euclid whether the way could not be rendered smoother, to which the Geometrician replied, no sire, there is no royal road to Geometry.

Archimedes, the greatest Geometrician of antiquity, was the first who discovered the ratio of the circumference of a circle to its diameter, not indeed with Geometrical strictness, but by a method of approximation, *admirable in its kind; and the source and model of* all the *approximate quadratures of* curvilinear spaces, when we are destitute of the means of determining them exactly. A. C. 250. The numerous discoveries of Archimedes, have placed him among the small number of those rare and inventive geniuses, who, from time to time, have given a great impulse to the whole body of Science. He wrote treatises on the sphere and cylinder, on spirals, on conoids and spheroids, and many other parts of mixed mathematics. He also extended and improved the principles of Geometrical analysis, the first principles of which had been established in the in the school of Plato. He equally excelled in the practical, as in the theoretical parts of the science; his invention is famed in mechanics; hydrostatics may be said to be a child of his own, which he nearly brought to maturity, and the burning mirror of Archimedes, has exercised the ingenuity of the curious to recover, and the reported wonders which his skill performed, have commanded the admiration, or attracted the scepticism of every succeeding generation.

We have to lament that many of his writings have been lost, but such as remain prove him to have been one of the greatest Geometers that ever lived. He has been termed the Newton of antiquity.

Archimedes was a lover of glory, not of that empty phantom, which the hero pursues midst scenes of desolation, massacre and rapine, but of solid glory, of that reputation, of that respect, which are due to the man of genius, who has enlarged the boundaries of science, whose labours are a lasting benefit to mankind. He desired, when he was dying, that a sphere inscribed in a cylinder, might be engraved on his tomb, to perpetuate the memory of his most brilliant discovery. His desire was obeyed, but the Sicilians his countrymen, having their minds turned on objects very different from Geometry, soon forgot the man, who is their chief honour in the eyes of posterity. Two hundred years after his death, Cicero, being then quaestor of Sicily, gave Archimedes to the light as he expresses himself a second time. Unable to learn from the Sicilians the place of his tomb, he sought for it by the symbol which I have mentioned, and some verses in Greek inscribed on its base. After much labour it was at length discovered, overgrown with thorns in a field near Syracuse, and the Sicilians blushed for their ignorance and ingratitude.

But Archimedes had raised to himself a monument more durable than sculptural praise. Yes, Archimedes! your wish is attained, you will receive, and you are entitled to it, the praise and admiration of generations yet unborn; your discoveries will be remembered as long as mankind value the pursuits of science, or value themselves; you will be ranked among the benefactors of mankind, among those who have done honour to human nature, when conquerors and kings are known no more, or remembered only with detestation. Fifty years after the death of Archimedes, another Geometrician appeared, by whom he was almost equalled, and who is at least the second of the ancient Geometricians. A. C. 200. This was Apollonius, who composed a great number of works on the higher Geometry of his time, most of which are lost or exist only in fragments; but we have almost the whole of his treatise on conic sections, the theory of which he greatly extended, most of the modern treatises on this subject consist of selections from Apollonius. Such accounts however are preserved in the mathematical collections of Papus, of his other treatises, that several of them have been restored by modern mathematicians. The age of Archimedes and Apollonius was the most brilliant era of ancient Geometry. After these two great men we meet with no other Geometrician of the first order in the period we speak of. Yet there are several others who enriched Geometry with interesting theories and discoveries.

The ancient Geometricians were perhaps too much addicted to abstract and theoretical speculations, and attached too little importance to the applications that might be made of them in practice; probably this is the cause, why the first origin of Trigonometry has fallen into oblivion. Yet Trigonometry affords curious problems, which must naturally have excited the researches of the early Geometricians. For instance, a person might have wished or even found it necessary to ascertain the breadth of a large river, without being obliged or without having it in his power to measure it directly. Now this and many other similar problems, are easily resolved by forming a triangle, one of the elements of which shall be the quantity sought. The principles of this part of Geometry are very simple. There are circumstances which indicate, that they were not unknown to the Egyptians, and we are certain they were familiar to the Greeks. On the contrary, the rise of Spherical Trigononometry was extremely slow; we have no reason to suppose, that it had made any progress, before the time of Menelaus, A. D. 55, who was a skilful Geometrician and a great Astronomer. His work on Spherical triangles is still extant. A hundred years before him. Theodosius had published a work on Spheres which may be considered as an introduction to Spherical Trigonometry. Most of his propositions now appear evident at first view, but faithful to the maxims of the ancients, he demonstrates every thing with the greatest strictness, and much elegance.

ON THE INVISIBILITY OF CERTAIN COLOURS TO CERTAIN EYES.

A VARIETY of cases have been recorded, where persons with sound eyes, capable of performing all their ordinary functions, were incapable of distinguishing certain colours, and what is still more remarkable, this imperfection runs in particular families. Mr. Huddart mentions the case of one Harris, a shoemaker at Maryport in Cumberland, who could only distinguish black and white, and he had two brothers almost equally defective, one of whom always mistook orange for green. Harris observed this defect when he was four years old, and, chiefly from his inability to distinguish cherries on a tree like his companions. He had two other brothers, and sisters, who, as well as their parents, had no such defect. Another case of Mr. Scott is recorded in the *Philosophical Transactions*, in which full reds and full greens appeared alike, while yellows and dark blues were very easily distinguished. Mr. Scott's father, his maternal uncle, one of his sisters, and her two sons, had all the same imperfection. Our celebrated chemist, Mr. Dalton, cannot distinguish blue from pink by day-light; and in the solar spectrum the red is scarcely visible, the rest of it appearing to consist of two colours, yellow and blue. Dr. Butters, has described the case of Mr. R. Tucker, son of Dr. Tucker of Ashburton, who mistakes orange for green, like one of the Harrises. Like Mr. Dalton, he could not distinguish blue from pink; but he always knew yellow, The colours in the spectrum he describes as follows:

1. Red mistaken for.........brown,
2. Orange ....green,
3. Yellow, generally known, but sometimes taken for ...orange,
4. Green mistaken for ....orange,
5. Blue ....pink,
6. Indigo.....................purple,
7. Violet ....purple.

Mr. Harvey has described, in a paper read before the Royal Society of Edinburgh, and which will soon be published, the case of a person now alive, and aged 60, who could distinguish with certainty only white, yellow, and grey. He could, however, distinguish blues when they were light. Dr. Nichols has recorded a case where a person who was in the navy purchased a blue uniform coat and waiscoat, with *red* breeches to match the *blue*, and he has mentioned one case in which the imperfection is derived through the father, and another in which it descended from the mother.

In the case of a young man in the prime of life, with whom the writer of this article is acquainted, only two colours were perceived in Dr. Wollaston's spectrum of five colours; viz. red, green, blue, and violet. The colours which he saw were *blue* and *orange* or *yellow*, as he did not distinguish these two from one another. When all the colours of the spectrum were absorbed by a reddish glass, excepting *red* and *dark green*, he saw only one colour, viz. yellow or orange. When the middle of the red space was absorbed by a blue glass, he saw the black line with what he called the *yellow* on each side of it. We are acquainted with another gentleman who has a similar imperfection.

In all the preceding cases there is one general fact, that *red light, and colours in which it forms an ingredient, are not distinguishable by those who possess the peculiarity in question.* Mr. Dalton thinks it probable that the red light is, in these cases, absorbed by the vitreous humour, which he supposes may have a blue colour; but as this is a mere conjecture, which is not confirmed by the most minute examination of the eye, we cannot hold it as an explanation of the phenomena. Dr. Young thinks it much more simple to suppose the absence or paralysis of those fibres of the retina which are calculated to perceive red; while Dr. Brewster conceives that the eye is, in these cases, insensible to the colours at the one end of the spectrum, just as the ear of certain persons has been proved, by Dr. Wollaston, to be insensible to sounds at one extremity of the scale of musical notes, while it is perfectly sensible to all other sounds.

If we suppose, what we think will ultimately be demonstrated, that the choroid coat is essential to vision, we may ascribe the loss of red light in certain eyes to the retina itself having a blue tint. If this should be the case, the light which falls upon the choroid coat will be deprived of its red rays, by the absorptive power of the blue retina, and consequently the impression conveyed back to the retina, by the choroid coat, will not contain that of red light.

MISCELLANIES.

Analogy between the Phenomena of Galvanism and those of Fermentation.—M. Schweigger has observed this analogy in the following points:

1. Galvanic piles, like fermentable mixtures exhibit their effects only by the reciprocal action of three different bodies.

2. The products of galvanic action are two, an oxidated body, and a *hydrogenated* body. The same happens with the products of fermentation, which are alcohol and carbonic acid.

3. The presence of electro-negative bodies favours the decomposition of water, whilst, according to Dobereiner, electro-positive bodies determine the formation of it.

M. Schweigger is of opinion, that the same results may be obtained with fermentable mixtures, as with electrical batteries; but several experiments, made subsequently by M. Dobereiner, stand in opposition to this hypothesis. Schweigger's *Journal Sur. Phys.* &c. vol. x. cah. 3d. 1824, and vol. xi. cah. 4, p. 457.

Highly calcined Charcoal a conductor of Caloric.—M. Cheuvreusse has found, that charcoal when highly calcined is a perfect conductor of caloric. When the charcoal is not much calcined and dry, it does not conduct caloric. M. Cheuvreusse proposes to use the first of these charcoals in place of copper in galvanic piles, and also for the purpose of carrying electricity into the ground from conductors.—*Ann de Chim.* Tom. xxix. p. 440.

To prepare a Metallic Tree, which may be removed from the vessel in which it is formed.—Mix together about equal parts of saturated solution of silver and mercury in nitric acid, diluted with a little distilled water; in this mixture suspend five or six drachms of pure mercury contained in a piece of fine linen rag doubled. The metallic solution will soon penetrate to the mercury inclosed in the cloth, and clusters of beautiful needle shaped crystals will begin to form round it, and adhere to the nucleus of mercury; when the arborization ceases to increase, the bag loaded with beautiful crystals may be taken out of the vessel where it was formed, by means of the thread by which it is suspended and hung under a glass jar, where it may be preserved as long as may be thought proper.

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A Committee of Civil Engineers and Practical Mechanics.

> "Improvements, unless in extraordinary instances of genius and sagacity, are not to be expected from those who have acquired all their dexterity from imitation and habit. One who has had an education no better than that of an ordinary mechanic, may prove an excellent manual operator; but it is only in the well-instructed mechanician that you would expect to find a good mechanic.—*Dr. Campbell.*

No. CXXV. *Saturday*, 13*th May*, 1826. Price 3*d*.

BAUP'S PORTABLE DRYING STOVE; VALLANCE'S MODE OF PROPELLING STEAM BOATS, &c.

Fig. 1.

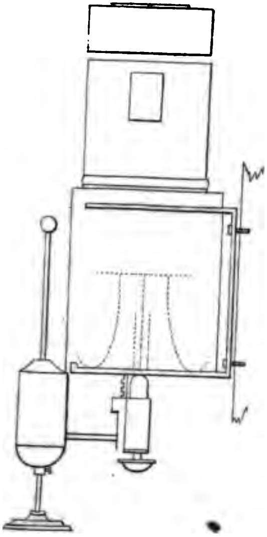


Fig. 5.

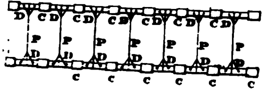


Fig. 2.

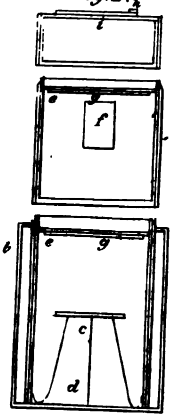


Fig. 6.

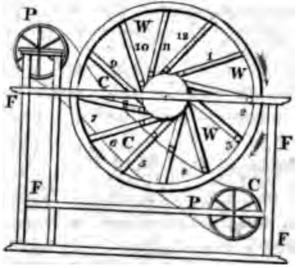


Fig. 4.

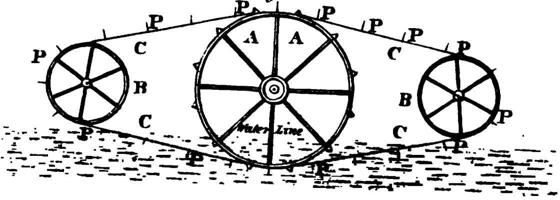
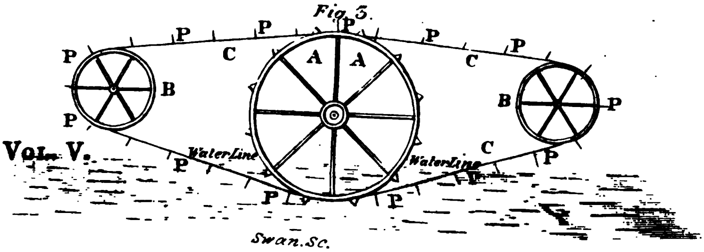


Fig. 3.



Swan. Sc.

PORTABLE DRYING STOVE,

INVENTED BY M. BAUP.

WHENEVER we are engaged in analytical researches on organized substances, we cannot fail to see the necessity of employing a stove, by means of which we can completely desiccate them, and determine, in the most exact manner, without subjecting them to any other change, the proportion of water which they contain.

It was either by heating them with steam, or by means of M. D'Arcet's lamp, that we ordinarily obtained this end; but, with the first, we could never exceed the temperature of boiling water; and even with the second, we could not obtain a temperature sufficiently elevated.

M. D'Arcet's stove is described, in Professor Thenard's Traite de Chimie, as consisting of a gradrangular chest, made of very dry wood; but the temperature in it could never be raised above 100° of the centigrade thermometer, even at the end of many hours. M. Baup endeavoured to improve this stove, by constructing it of pasteboard, in a cylindrical form, and thus avoiding that loss of heat which was occasioned by the useless spaces in the angles: he also made that part of it which was directly exposed to the heat of the lamp double, and so contrived it, that he could observe the progress of the temperature within.

This apparatus completely answered the end proposed; as he could not only regulate the temperature at pleasure, but also raise it, by a little at a time, to 150° of the centigrade thermometer, or even a little more. We have thought it our duty to give a description of this stove; and to recommend the use of it to all chemists who are engaged in similar researches.

This ingenious stove is composed of three principal parts, which are all cylindrical: each cylinder is formed by uniting two sheets of pasteboard together with strong glue, and in such a manner that the inner one should exceed the outer one a little in height, and that the edges which thus project should fit into corresponding recesses formed in the lower edges of the second and third cylinders, and thus serve to keep the three pieces steady, the one upon the other.

The lower part, which is the fire-place, has a circular hole made in the middle of a piece of pasteboard, which serves as a bottom to it, in order to introduce the glass chimney of an argand-lamp: it is also surrounded, at the distance of two or three centimetres, with another cylindrical envelope, consisting of a single sheet of pasteboard. The space between the two cylinders is filled with carded cotton or wool; and the top is, lastly, closed by a circular band of pasteboard.

This first piece is surmounted by a second, and that by a third, performing the office of a cover. In the middle of the cover of this last piece a circular opening is made—a little larger than that which, as above mentioned, was made in the bottom of a stove—to afford entrance to the glass chimney: this is intended to permit the humid air to escape, and to clear the interior of the stove; and a plate of glass is fixed on one side of it, in such a manner as, by turning it more or less, the opening may be diminished at pleasure.

In the first and second pieces, near their tops, a circle or ring of pasteboard is fixed; which serves to support iron-wire gratings, on which are to be placed the substances intended to be desiccated.

There is a circular iron plate, pierced with holes around its border, supported upon three iron wires placed in the lower part, or fire-place: its use being like the mushroom in M. D'Arcet's stove, to prevent the heat of the lamp from acting upon one point only, and to distribute it equally.

Lastly, the lower part or fire-place of the stove is held within, and supported by an iron frame, which can be fixed against a wooden plank or wall, by means of two screws or nails.

In the annexed engraving, fig. 1. shews a general view of the stove, and fig. 2. a vertical section of the same apparatus, in which is seen the fire place; *b b*, envelope; *c*, tripod; *d*, lower opening, to admit the glass chimney of the lamp; *e e*, rings of pasteboard, to support the gratings; *f*, a small glazed window; *g g*, gratings; *h*, a plate of glass fixed on the cover; *i*, the upper orifice.

In order to use this stove, the glass chimney of the lamp must be introduced as high as possible, at the lower opening: and the space between the glass and this opening must be well closed, to prevent the entrance of cold air. When we wish to obtain the maximum of heat, the upper orifice must be closed, by means of the glass plate, as much as possible; permitting only as much air to escape as is necessary to prevent the lamp from smoking.

From a stove constructed as above described, and of the following dimensions; viz.

	metre.		*foot,*
Height of the lower part, or fire-place - -	0,3	or	1
Total ditto of the two upper pieces	0,3		1
			inches.
Interior diameter of the stove	0,2		8
Thickness of the space filled with carded cotton -	0,02		2

we obtained the following results:—Before the envelope was added to the fire-place, the loss of heat was so great, that a centigrade thermometer, placed on the lower grating, was not elevated to more than 120°. With the pasteboard envelope, the space remaining empty, the thermometer mounted to 130°. The interval being filled with charcoal, it required a greater time even to arrive at the same degree of 130°; and beyond that it never reached. Lastly, having substituted, for charcoal, either feathers, wool or carded cotton, the heat progressively increased to 150°, and even to 160°, although less rapidly; entirely owing to the fire-place being insulated by these bodies, which are bad conductors of heat.

* * *

PADDLE CHAIN FOR STEAM-BOATS.

BY MR. DIXON VALLANCE, LIBBERTON.

GENTLEMEN,—The defects of paddle wheels are well known, and have already been repeatedly pointed out in the pages of your valuable Magazine. In the accompanying sketch is shewn, what has been considered by all who have seen it, an improved plan of propelling paddles. I am aware, a chain with paddles affixed to it has already been tried, and has been found defective both in entering into, and rising out of the water; but I conceive that this is remedied in my plan. A, A, (fig. 3,) is a large wheel or drum, having studs on its circumference to work the chains both above and below. B, B, two smaller drums, over which the chain passes, which serve to keep it in the proper position, and each of which have raised edges to prevent the chains from slipping off. One of the small drums is made to move by a screw, so as to tighten or slacken the chain when required; and both may be made to fix either higher or lower, so as to give the paddles a greater or less sweep or stroke of the water. In fig. 3, the paddles, chains, drums, and the water line are shewn, the small drums being raised above the centre of the large drum. The same is shewn in fig. 4, but the centre of the three drums are in one straight line. Fig. 5. shews a part of the chain with the paddle boards fixed on it, and supported at each end with iron clasps bolted to the chains. E, E, E, E, are parts of the chain; P P, P, P, the paddle boards; and D, D, D, D, the clasps.—I am, Gentlemen,

Your obedient servant,

Dixon Vallance.

Libberton, Lanarkshire 10th March 1826.

PERPETUAL MOTION.

By Dixon Vallance, Libberton, Lanarkshire.

Gentlemen,—You were pleased to insert some time ago, a description of what I called a perpetual motion, or self-moving machine. I observe, however, that in No. 103, Vol. IV. of your Magazine, p. 270, it has been examined, and wrongly represented by a correspondent who signs, B., Port-Glasgow. I assuredly think that this gentleman should have understood the machine before saying any thing about it. He begins by telling us that the spokes are open on one side of the wheel, from the centre to the circumference. Now, I beg to tell him they are close on both sides. He next tells us that the chain touches the spokes, but the chain only touches the rolling weights, and the pullies round which it goes. The drawing now sent (fig. 6) represents the machine with angled spokes, which allow the rolling weights to run off above the centre. In this machine, the angle between the chain and the spokes is less acute than in the other which has spokes straight out from the centre, and of course it has more power. W, W, W, the wheel with 12 hollow spokes, having an opening in them to allow the chain to pass freely, and to meet the weights. C, C, C, the chain passing over two pullies. P, P, the pullies. F, F, F, F, the frame of the machine.

Your's, &c.

Dixon Vallance.

[Our friend, Mr. Vallance, is probably not aware that machines on the same principle with the above have been repeatedly tried, and as often found to fail. Indeed until he can remove the effects of friction, he will not get this amended machine to continue to move any time. It is not to be disputed, that the friction of the rollers or the chain, and the wheel itself will completely compensate any power derived from the weight which the descending balls may have over the ascending.—*Eds.*]

ON THE ORIGIN OF AREOMETRY.

HYPATIA, an illustrious female, the daughter of a Platonic philosopher at Alexandria, is generally supposed to have been the inventress of the areometer. She taught philosophy at Alexandria about the end of the 4th century and was equally celebrated for her virtue, science and beauty. She was killed by a mob of the Alexandrians, raised against her by St. Cyril in the year 415. The invention of the areometer is ascribed to her, and probably with great justice upon the authority of the 5th letter of Synesius, a cotemporary and friend of this celebrated lady. This philosopher, writing Hypatia, compliments her upon her discoveries, and the areometer among the rest. But among the ancient authors that have come down to us, there is a poem *De Mensuris et Ponderibus*, in which the invention is ascribed to Archimedes who flourished 650 years before Hypatia. Both are probably true, for, with all the advantages of the art of printing, we find that valuable inventions are forgotten, and re-invented during the lapse of periods much shorter than six centuries. Such as are conversant with the writings of Boyle, Hook, Wren, &c. or with the registers of learned societies, or scientific correspondence during the 17th century will be fully convinced of this; so that Hypatia may have been the second inventor.

In the poem above alluded to, the following description is given of areometry, which is equally valuable for its perspicuity and exactness.

"A cylinder is made of silver or thin brass, in length equal to the distance between the knots of a brittle reed. The lower part is loaded within so that it shall neither totally sink nor entirely float. A line is drawn from the upper to the lower extremity of its surface, and divided into as many portions as the scruples which express the weight of the cylinder. With this instrument, the relative weight of any fluid may be ascertained; for, if it be light, the cylinder will sink deeper; or if heavy, the number of divisions above the surface will be more considerable. If equal bulks of different fluids be taken, the densest will exceed the other in weight; or if the weights be equal, the rarest fluid will occupy the greatest space. For example, if the cylinder be found to sink through 21 divisions in one fluid, and in another through 24, it may be concluded, that the heavier exceeds the other by 3 scruples or one drachm. But it is more accurate, instead of attending to the difference, to compare the two fluids, by attending to the quantities of each in magnitude, which are displaced by the immersed part of the cylinder."

The poem from which this extract is made, is usually printed at the end of Priscian's Works, and is generally allowed to have been written about A. D. 80 or 90. It cannot therefore be doubted but the areometer was an instrument well known and commonly used 300 years before the birth of Hypatia. In the poem, as we said already, the author evidently ascribes the invention to Archimedes; for, after the above description, he says,

"Nunc aliud partium ingenio trademus eodem,"

"Let us now describe another invention of the same genius." After which he proceeds to describe the method used by Archimedes to ascertain the quantity of silver in Hiero's crown. From the same poem we learn that experiments of considerable delicacy had been performed in areometry, as where it says, "The weights of river, well, and spring waters are different, as are also the wines, according to the place of their growth on hills or plains, and according to their age.

ESSAYS ON BLEACHING.

BY JAMES RENNIE, A. M, LECTURER ON PHILOSOPHY, &c. &c. LONDON.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

SECTION II.

2. *Bucking.*—This is one of the processes which has lately received important improvements from the invention of an apparatus called the whale boiler, whose operation has already been described. But whether this be used, (and it is not yet general,) or the old apparatus, the goods are treated precisely in the same way, and it is a very important part of the whole operations. The first thing to be attended to in bucking is the preparation of an alkaline ley of a proper strength. For this purpose the crude alkali is to be broken into small pieces not exceeding the bigness of a hazel nut, or bruised by means of a horse mill, and put into the boiler with a proper quantity of water. It would be an economizing of fuel to put this into the boiler immediately on drawing off old leys, when the heat of the boiler and its fire place, supposing a small quantity of the fire to remain, the registers of the furnace being shut up and the boiler covered, will be sufficient to melt the alkali in the course of the night. The liquor ought not to be permitted to boil, for Dr. Home, (p. 103,) proves by experiment that salts from ashes by boiling are not so strongly alkaline as the ashes themselves. If pearl ashes are added to a ley made from the other crude alkalies, they need not be put in till the solution is nearly completed, as their greater quantity of carbonic acid renders them much easier to dissolve. Those who pursue the older modes of bleaching, put the goods into the alkaline solution which is thus prepared; but as its strength can be, according to Kirwan's experiments, increased one-half by the addition of so cheap an article as quick-lime, this ought never to be neglected, particularly also as chemistry informs us, that no alkali will combine with any oleaginous matter (unless it be in a state of causticity). It is of great importance to attend to this when American pearl ash is used, as it always contains a large proportion of carbonic acid. Des Charmes advises to take of quick-lime the whitest which can be had, a third or a fourth part in weight of the solution, and heat up in a bag or cloth to prevent it from rendering the ley turbid. A better method is to add one part of well-burned fresh-slaked and finely pulverized quick-lime, to two parts of the alkali dissolved as above. When the lime has been added, the mixture is to be brought to boil, taking care to keep it in constant agitation with an iron rake, to prevent the lime from subsiding and fixing on the bottom of the boiler. When the ebullition has commenced, it will produce sufficient agitation to keep the lime suspended. The boiling may be continued for two hours, when the lime may be allowed to subside and

the clear supernatant liquor now in a state of causticity from the loss of its carbonic acid may be run off for use. The lime which has subsided is to be washed with water till it come off clear without alkaline taste, and the washings are to be kept for making fresh leys. The bleachers ignorant of Chemistry, erroneously imagine that the lime imparts some of its properties to the ley, but as the precipitated lime is found to be a carbonate, it clearly appears that it has by superior affinity abstracted the acid from the carbonated alkali. Des Charmes says that it is not necessary to add lime to American and Russian ashes, as they contain a large proportion of it when imported, but he surely forgot that this lime is commonly in the state of a carbonate, and therefore cannot take up the carbonic acid which renders the ashes mild.

I have stated, that in rendering alkalies, caustic quick-lime is to be added in the proportion of two to one by weight, but this is somewhat vague, and will not apply where there is much difference of quality in the alkalies. It will consequently be of importance to ascertain some test by which to determine when a proper quantity of lime has been used. For this purpose, when the boiling of the moisture has been stopped, take a little of the supernatant liquor in a wine glass, and breathe into it through a small glass tube, or add to it a few drops of clear solution of subcarbonate of pot-ash; if there be a redundancy of lime, the dissolved earth will absorb the carbonic acid from the human breath, or from the pot-ash, and will render the liquor turbid. If it does not become turbid, add a little lime-water, and if this occasions turbidness, it shews, that the liquor contained carbonated alkali, and has not had a sufficient quantity of lime. If the lime be in due proportion, the ley will neither shew turbidness from these tests nor will it effervesce with acids.

It is of the greatest importance to the bleacher to be able to determine readily, the specific gravity of his leys, as they must be used as nearly as possible, of the usual strength: ley of 1.0127, or 1.0156 specific gravity is what is commonly employed. To ascertain this, the hydrometer is generally used. A new instrument of this sort was sometime ago proposed by Professor Lesslie, (Ph. Mag. XVI. 200,) but I have not heard whether it has ever come into use. It was to be constructed on the principle which he has fully demonstrated—that capillary attraction is nothing more than the specific relative attraction of solids and fluids, and the purity of the liquid examined would be indicated by its ascent in a capillary tube graduated with enamel colours. The instrument in common use is not so simple nor so elegant. Those which were formerly employed were constructed on a fixed principle, so that when one of them was broken, another could not be made to the same scale. This inconvenience however has now been removed by the ingenuity of Mr. Tweedale of Glasgow, whose hydrometers are now universally used. The method which he adopts is to commence the scale at 1, and to make every degree indicate .005 of specific gravity. Hence, supposing the alkaline ley to indicate 20° on the scale, its specific gravity would be $1. + 20 \times .005 = 1.100$, the specific gravity of water being unity. A complete series of these numbers from 1 to 6 indicates the specific gravity of fluids from distilled water, as 0. to sulphuric acid, 2. the heaviest liquid known. In using such instruments it is necessary to attend to the temperature of the atmosphere, as all bodies are greatly influenced by their sensible caloric, and their bulk increased or diminished according to the quantity which they contain. In water the fifth decimal figure changes with every degree of Fahrenheit's thermometer, other fluids observe different rates. Some bleachers guess at the strength of their leys by the taste, but this must at best be an uncertain criterion. Des Charmes tells us that the laundresses of France ascertain the quality of leys from their lubricity when rubbed between the finger and thumb, or from the readiness with which they absorb the colouring matter of the goods.

When leys are made caustic by means of quick-lime, and drawn off for use, they will commonly be of the same strength at the top and bottom of the vessel. But when they are not removed from the boiler, but the goods put in as soon as the solution has been effected, the liquor will be often three-fourths stronger at the bottom than at the top, from the undissolved alkali continuing to melt. This ought to be carefully attended to, as it is contrary to the general law which obtains in solutions, namely, that they are of equal strength throughout. Dr. Home supposes the anomaly to depend on the presence of lime in a state of mechanical mixture.

It is of importance that the ley should be always as clear and limpid as possible, for if the lime remain either in solution or suspension in the smallest proportion, it is apt to be precipitated into the fabric of the cloth, and will be fixed by the sulphuric acid sour which will produce an insoluble delenite. This however is not of so much consequence for the two or three first immersions, as it is when the goods have once acquired an even colour, and require only to be brightened. It is then essential for the saving of time and labour to have them as colourless as possible.

Des Charmes directs the goods to be put into the bucking apparatus in a moist state; Dr. Home, that they should be dry, in order, he says, "that the salts may enter into the body of the cloth, along with the water, as they will not enter in such quantity if it be wet, and by acting too powerfully on the external threads may endanger them." The Doctor's reasoning appears to me perfectly just.

The goods which have been treated as already directed, are placed in the kieve in open folds, as in the steeping process, and a quantity of the caustic ley is poured over them, sufficient for their thorough immersion, (heated to the temperature of the blood). The heat is increased very gradually till it reach the boiling point, when it is thrown up against the umbrella and spread by it over the surface of the goods, through which it percolates into the boiler again, and so on in succession till it be saturated with impurities. This is known from its losing its causticity and acquring an offensive smell, or from the deepness of the colour both of the ley and the cloth. The success of the process indeed is commonly estimated in proportion to the deepness of the colour which the cloth has acquired. (Home, p. 72.) Particular attention ought to be given to the gradual increase of temperature now directed. For the resinous or oleaginous colouring matter of the cloth, the twisting of the threads, and closeness of texture, must hinder the liquid from penetrating it, particularly at first, so that if the ley were poured on at 212° the cloth might be liable in several parts to a dry heat. This is usually illustrated by the general

which heat produces on
d vegetable matter. Thus
egetable is to be softened, or
its juices extracted, it is
hat this can best be done by
ng with moderate degrees of
han by plunging it all at
boiling water, which would
harden it and fix its colours.
are well aware of this, and
when they wish to preserve
en colour of vegetables after
, never put them in till the
as acquired its highest tem-
re. The same reasoning ap-
the process of bucking: and
lso it is confirmed by experi-
as goods which have unfor-
ly been put into boiling ley in
rst instance, can never be
t to a good white. Dr.
is so much impressed with
nportance of this, that he
it advisable to keep the ley
the boiling point for the two
uckings; but this is surely
g the caution too far.

Charmes' method excluded
as unnecessary, it being suf-
, he thinks, that the ley be
d sufficiently abundant. He
out his goods when the liquid
the cover in the middle of
ap is too hot to admit of the
being held in it, or when it
rs round the circumference
boiler, and throws up white
s, which circulate towards the
. Frequently he only plunged
ods for a few minutes into ley
ery gentle heat, and he found
y this treatment both cotton
iece goods bleached perfectly

e leys, when the above circum-
s are indicated, are to be
off, and warm water poured
he cloth in the kieve which,
mbining with part of the re-
ng impurities which have been
ed, serves to carry them off. When this has been done, a stream of cold water is allowed to play on the goods, till it run off nearly limpid, after which they are taken to the dash wheel; the reason for this process, which is not always properly attended to, is, that were the cloth carried from the kieve to the dash wheel while hot, a certain portion of the colouring matter would be again fixed in it, which would not easily be again removed.

The process of bucking is successively repeated even as often, or 10 times before the operations are finished, and with leys of different strength. I find that with respect to the variation of the strength of the leys there are two modes recommended directly opposed to one another. Des Charmes says it is advisable to keep the leys at the same degree of force during the first two or three immersions of the same goods, *diminishing the strength one third or one fourth,* as soon as the pieces have acquired a uniform colour. In this period weaker leys may be advantageously used, because there remains scarcely any thing more of impurity to be carried off; and the subsequent process may be considered merely as a brightening of the colour by detaching the small portion of impurity which may remain fixed in the texture of the thread, (p. 81.) With this agrees the experiments of Mr. Roe of Bings, and (Report on Experiments, &c. Dublin, 1791.) The practice of our bleachers in Scotland and Ireland is directly the reverse of this. They use the weakest leys at the commencement, and increase them in strength as they proceed. Dr. Home's reasoning on this seems to be conclusive. "The leys," he says, "should be weakest in the first buckings, because then they act only on the more external parts, but when the cloth is more opened, and the field of action increased, the chemical agent ought likewise to be invigorated," (p. 61–2.) This argument, and the uniform practice of our most enlightened bleachers should, I think, clearly determine this point.

In repeating the bucking process most bleachers occasionally use leys which have formerly been used for a similar purpose even more than once. This practice we have already reprobated when treating of steeping, and in the present case it is of no less importance to avoid it, particularly in bucking fine goods. They seem to have been led to this bad practice from its apparent economy, but when it is considered that it is only the unsaturated portion which can act, pure ley must evidently be cheaper. Besides, cloth bucked with foul ley, becomes heavier instead of lighter, and consequently must receive impurity from it. Des Charmes directs a mixture to be made of foul with new ley, adding a third or fourth of the latter ; but these added portions of fresh ley must be greatly impaired in strength, by taking up the impurities with which the old ley is loaded, and this is found to agree with experience. It is of some consequence to remark, that little advantage can arise from several buckings *immediately* succeeding one another : even the second immersion in the ley will frequently leave it quite limpid. Des Charmes found it of most advantage to use the ley rendered caustic by lime at the commencement of the buckings than afterwards, when it might impair the texture of the goods.

NEW WEIGHTS AND MEASURES.

TO THE HON. MUNGO NUTTER CAMPBELL, Esq., LORD PROVOST OF GLASGOW.

[We have been favoured by our learned contributor with the following additions to his important article on Weights and Measures which appeared in our last week's Number.—*Eds.*]

My Lord,

The *minimum* capacity of the heaped bushel measure occurs when the cylinder is 8 inches deep, and its cone is 6 inches high ; the *maximum* capacity, when the cylinder is 8 inches and nine-tenths deep, its cone being three-fourths of that quantity, or 6.675 inches high. Every intermediate proportion is legal, because in all that range, the outside diameters of the vessels being 19½ inches, "the inside diameters may be at least double the depth thereof," and the axes of the cones may be to the axes of their subjacent cylinders in the proportion of 3 to 4. This range has been left open by the framers of the Act of Parliment, to suit the convenience of measure-makers in respect of the thickness of the vessels.

The *minimum* inside diameter of the bushel cylinder, compatible with the limitations of the Act, is 17.814 inches. Deducting this number from 19.5 inches, the difference, 1.686, divided by 2, gives 0.843, or nearly 27 thirty-two parts of an inch for the *maximum* thickness of that measure.—Hence it appears, that, from this, down to the *minimum*

ness of 3-eighths, scope is left
e constructors of vessels of no
han 15 thirty-two parts of an
by the judicious foresight of
ramers of the law. To this
nable scope the above degree
of vagueness in the capacity of the bushel cone is owing.—I have the honour to be, with much esteem,

My Lord,
Your Lordship's most obedt. servt.
Andrew Ure.

THE WEATHER IN THE HOLY LAND.

o tells us there is no winter in
t. His following words shew
e meant no rains, no hail, no
ler, no violent storms of wind,
constitutes an eastern winter.
e manner Maillet quotes Pliny,
rming there were no rains, no
ler, no earthquakes in that
ry: Maillet, however, affirms
e had seen it rain there several
, and that there were two
quakes in Egypt during his
ence in it. He supposes, there-
that the "non tremit" of Pliny
fies it seldom feels earthquakes,
when it does, is not damaged
em; the "non pluit," "non
," that it seldom rains, seldom
ders there, though, as to the
oast the rains and thunderings
ften very violent, but it does
ain there as in other countries.
an eye-witness, confirms Mail-
account of the rain of Egypt,
ing us, that when he was at
, which is at a considerable
nce from the sea-coast, it rain-
that degree, that having no
els in the streets to carry off
ater, it was ancle-deep, and in
places half way up the leg.
Bishop Pococke assures us,
even in the Upper Egypt it-
t hailed and rained almost all
orning, when he was there in
onth of February, and that it
l very hard the night following;
hat, on the 18th of that month,
ined at Gasa Kieber in the
, and again after it was day,
gain in the evening.

We may understand by these accounts what the sacred writer means when he says Egypt has no rain, (Zech. xiv. 18.) He must be understood in the same qualified sense that Maillet, or rather the Abbot Mascrier, puts upon Pliny; in the same qualified sense we must understand Philo; and, consequently, all that is necessary to understand by the expressions, "There shall be no dew nor rain," is, that they should not be in the usual, in the necessary quantities. Such a suspension of rain and dew was sufficient to answer the chastising purposes of God; and an absolute drought of three years' continuance must surely have destroyed all the trees of the country, as well as occasioned a temporary famine; but no destruction is intimated in the Scriptures.

Those prodigious long droughts that have happened in Cyprus, one of seventeen years, and another of thirty-six, must have been, one would think, of the same kind, not such favourable seasons of rain as they often enjoy, when they have a prodigious plenty of corn, but however not a total suspension. Yet a late traveller, speaking of these celebrated droughts, says, no rain fell in the space of seventeen years. Had this been, strictly speaking, the fact, one would imagine, that not only the inhabitants must have quitted the island, which he tells us they did, but almost every vegetable must have perished.

This suspension of rain in the

time of Elijah was for three years and six months, according to the apostle James, ch. v. 17. If the rain was only withheld three winters, it would, in the common course of things, have been a withholding rain for about six months more than the three years, strictly speaking, because the summers of the East are dry. It would, however, have been more natural to have expressed it by a drought of three years; but if the usual rains were withheld four winters, and first appeared late in the spring after their suspensions there would be a great energy in this form of speech—three years, and six months.

GRANULATION OF SHOT.

The manufacture of common fowling shot consists merely in causing the fused metal to fall in equal spherical drops into water. The lead is melted with the addition of a small proportion of arsenic, which, being reduced to a metallic state, by means of grease stirred in during the fusion, renders it less fluid. An oblong shallow vessel of iron, perhaps 10 inches wide, 14 long, and 2½ deep, called a *card*, whose bottom is pierced with holes proportionate to the intended size of the shot, is placed at the height from one to three inches, over the surface of a tub of water, covered with a thin film of oil. The card is previously heated to the temperature of the metal by immerging it in the cauldron; and a stratum of soft dross or scoriæ, which are found on the surface of the fused alloy, is then placed on its perforated bottom, and, being slightly pressed down with the laddle, forms a kind of filter, which partly chokes up the apertures, and prevents the metal from flowing through in continuous streams. The fused metal is then poured by laddlefuls into this vessel, and appears notwithstanding to run through it with considerable velocity; so that it seems difficult to believe that it falls in separate drops, till convinced by taking up a quantity of shots from the bottom of the water.

The shot thus made is not without considerable imperfections. The exterior coat of the lower part of the drop becoming suddenly fixed by the contact of the water, its superior portion, which is still liquid, as it also cools and contracts, necessarily pits, like the surface of metal in the channel of a mould, so that the greater part of the shot is somewhat hollow and of an irregular form; consequently too light for the purpose to which they are destined, and liable to unequal resistance in their passage through the air.

These defects are remedied in the patent shot, the manufacture of which differs only from that of the preceding kind in the addition of a larger portion of arsenic, which varies according to the quality of the lead; *in dropping it from such a height that it becomes solid before it enters the water*, which is from 40 to 100 feet; and in some subsequent operations, which are as follows: It is first dried and sifted. It is then *boarded*, which consists in scattering it on several polished slabs or trays of hardwood, with rims, in the form of a Π, except that the sides converge towards the lower part, to which a slight inclination and alternate motion in their own planes are given by boys employed in the manufacture. The shot whose form is imperfect are detected by the sluggishness of their motion, and remain behind, whilst the others roll off from the board. The last operation is the polishing; which is performed by agitating it, with the addition of a very small quantity of black lead, not exceeding two spoonfuls to a ton, in any iron vessel, turning on an horizontal axis like a barrel-churn. It does not appear that any higher degree of perfection than that which is thus attained remains to be desired. The argentine brilliancy of the shot when newly made, the beautiful accuracy of its form, and the curious instance of inanimate tactics which it presents when scattered on a plate, render it even an agreeable object of contemplation.

ON THE DIFFERENT PROPERTIES OF METAL AND WOODEN SPRINGS.

The spring is, in a variety of pieces of mechanism, not only a very useful auxiliary, but in some (as in pocket-watches, gun-locks, &c.) an indispensible requisite. But from the difficulty of getting springs to stand, as the workmen express it, to their temper, they are not so frequently applied to the purposes of mechanics as otherwise they might be. Great judgment and skill, as every one knows who is conversant with the subject, are required to give to a metal spring its due degree of temper; for, if made too hard, it snaps, if not hard enough, it sets. Metal springs, however, frequently fail from another cause, which is very little understood, in consequence of which, the failure is usually attributed though, as will be presently seen, unjustly, to the unskilfulness of the workmen. It is a circumstance not commonly observed respecting a metal spring, that if it has not something to stop against, but is suffered to vibrate after performing the requisite action, it will, in a short space of time, if the action be frequently repeated, either break or set; whence this property arises is not at present the object of inquiry. It is mentioned that, in cases which will admit of it, this inconvenience may be guarded against. In those cases in which the vibration cannot conveniently be avoided, a wooden spring, which is not subject to the like inconveniency, is the best, and, perhaps, the only substitute. A wooden spring is, in the property alluded to, the reverse of a metal one: if stopped in its vibration, it soon sets or breaks; if permitted to vibrate, its temper or elasticity suffers not the smallest diminution.

A gentleman, some years ago, established a mill for a manufacturing purpose, in which, having occasion to apply springs under the circumstances mentioned above, he at first attempted to make use of metal ones, but in vain, being never able to make them stand a single day's work. He tried every kind of steel, and employed many different workmen, but still without success. Merely as a temporary expedient, till such time as he could get a fresh supply of steel springs, he one day tried a wooden one, which, to his agreeable surprise, completely answered his purpose; and from that time, as may be concluded, he never used any other than wooden ones. The experiment was perfectly decisive: the springs were in daily action for four years successively, making, in a common way, from forty to fifty strokes in a minute on an average. At the expiration of the four years, those springs which had escaped accidents were as elastic, and as strong, as when first put into action. The wood they were made of was red deal, clean grained, and perfectly free from knots.

To many manufacturers who employ machinery for various purposes, in which springs that must be suffered to vibrate, form a part, this information, which may to some appear trivial, will be found highly useful.

MOTION OF THE PLANETS.

GENTLEMEN,—It is with extreme regret, that it has not been in my power until now to advert to the objections stated in No. LXXXV. of your Magazine, regarding the paper which appeared in No. LXXXII. upon the motions of the planets. Having very shortly after forwarding that communication, removed to a part of the country where I had not the opportunity of receiving your Nos. as I had formerly done, I knew nothing of the paper in which Mechanic's objections were stated, until the other day when I was taking a cursory glance over Vol. III. of your Magazine. Trusting that no further apology will be deemed necessary for my being so delatory in answering your correspondent's paper, I shall now advert to those parts of his paper, which are the more immediately connected with mine. All your correspondent's objections tending to refute the *Cartesian* system occurred to me long before I wrote that paper, or had even a thought of doing so; but it will be requisite here to remark, that it is not altogether the opinion of Des Cartes that I have been led into. I only adopted that term, as the idea which I had formed of the planetary motions had a nearer coincidence with his than any other with which I was acquainted. The opinion impressed upon my mind with regard to the planetary system was, that the sun's axial motion is the cause of the annual motions of all the planets, and that their centrifugal forces are counteracted not by means of any fluid, but by the natural tendency which the rotatory motion of any body moving round a central one has in keeping it from being carried away by the centrifugal force, upon the same principle by which the rotatory motion of a curling stone counteracts the tendency which a declivity of the ice has in drawing it away from the straight line in which it would otherwise move. It will be seen from what has been here said, that according to this system, the planets are retained in their orbits not by any fluid, but by their own rotatory motions, which does away with your correspondent's objections, as they are merely calculated to prove the nonexistence of such a fluid as that by which Des Cartes supposed the planets to be detained in their orbits. Amongst other proofs which might be brought forward in favour of this system, we may observe that the cause of Jupiter's satelites having such a quick motion round him, may be the velocity with which he moves upon his axis, and although the moon's turning only once upon her axis in her revolution round the earth may be stated as an objection against this theory, yet this objection will appear to be of no consequence, when we consider that the earth goes through more space in the time of one revolution upon *her* axis, than the moon does in one revolution upon *hers*. However, being conscious that this system must depend almost solely upon the existence of such a kind of compound motion as I have adverted to above, and as I have never yet seen any notice taken of such a motion in any treatise upon Dynamics which I have hitherto perused, it is *this*, in particular, that I would wish to draw the attention of your correspondent, or any others who may have made the science of Astronomy their study. Should the above observations be deemed worthy of a place in the columns of your useful Magazine, their insertion and whatever remarks may be made upon them by any of your numerous correspondents will much oblige,

Your's,

R. B.

Glasgow, 26th April, 1826.

MISCELLANIES.

Rum Jelly.—Among the novelties of the Parisian circles, rum-jelly has become an universal favourite. It is made in the following manner:—To a quart bottle of common white wine take a pound of sugar, which is to be reduced to a syrup, and clarified. Then take an ounce of isinglass, which put on the fire till it is thoroughly melted, pass it through a cloth, and mix it with the syrup half warm. When this mixture is nearly cold, pour it in the white wine and stir it well so as to mix it completely. Then add a spoonful or a spoonful and a half (according to the strength which you desire to give to the jelly) of old Jamaica rum. Stir again the mixture, and pour it in the mould that it may take the shape in cooling, which you design to give it, if intended as a *plate* for the table, or into glasses, if designed to be handed round at an evening party.

Mean Temperature of the Equator.—From a comparison of various observations, M. Humboldt made the mean temperature of the equator 81° 5, while Dr. Brewster, in his formulæ, makes the mean temperature of the equator in the old World 82° 8. This curious subject, however, has been ably discussed in a memoir on refraction and temperature, by Mr. Atkinson, who, from a careful examination of Humboldt's observations by the method of minimum squares, has obtained the following results:—

"1. The whole of Humboldt's observations, both in North and South America, at or near the level of the sea, indicate that the mean temperature of the equator at the same level is 86° 55 of Fahrenheit.

"2. All the observations, nine in number, made within 11° of the equator, where the height does not exceed 3500 feet, indicate that its temperature is 84° 53. But if Caripe be excluded, as it probably ought, the remaining 8 give 85° 273, for the mean temperature under the equator.

"3. If those places only be taken, which are within the same limits, and whose height is less than 2000 feet, they indicate that the mean temperature is 84° 93."

It thus appears, says Mr. Atkinson, from data, furnished by himself, that Humboldt has fallen into an error, when he asserted that the mean temperature of the equator cannot be fixed beyond 81° 5'.

Prussian Blue in the Soda of Sicily.—In three parcels of soda from Sicily, M. Brandes has obtained Prussian blue. When he heated the soda with warm water in a white iron vessel, he obtained much more of the Prussian blue than when he dissolved it in a porcelain dish. *Arch. des Apoth. ver.* 1822, No. 3. p. 215.

On Rinmann's Green.—This colour is an intimate mixture of the protoxide of cobalt and the oxide of zinc, which assumes a very lively green tint, after it has been heated to redness. In order to form this green, suddenly, as if by the eruption of a volcano, mix together two parts of nitrate of zinc, and one part of the subacetate of cobalt, and expose the mixture to a spirit of wine lamp in a glass globe, with a short neck. This mixture soon becomes liquid, and appears at first of a rose-red colour, then purple, then blue. In an instant it inflames, detonates, becomes dry, and assumes a green colour. The product is scattered upon the vessel in the form of small rolled leaves of tea. *Bull. des. Sc. Nat.*, May, 1824, p. 292.

Oxalic acid found in great quantities in lichens, &c.—M. H. Braconnot has discovered that oxalate of lime forms nearly one-half of the weight of a great number of lichens, to which it bears the same relation that carbonate of lime does to corallines, and phosphate of lime to bones. The oxalate diminishes progressively in the family of lichens, as the species loses their crustaceous granular texture, and acquire a foliated membranceous aspect, but the latter still contain a remarkable quantity. About 17 parts of yellowish white oxalic acid were obtained from 100 parts of the pulverised lichen. *Ann. de Chim.* xxviii. p. 318.

Action of Nitric Acid on Charcoal.—Professor Siliman having announced the formation of hydrocyanic acid, by the action of nitric acid in charcoal, M. Frisiani was led to the same result in the following manner: in treating with nitric acid the residue of the calcination of sulphate of barytes with charcoal, he smelt bitter almonds. This made him suppose that the prussic acid was formed. He repeated the experiment in a glass bottle, and heating the liquor with sulphate of iron, he obtained prussian blue. The boiled nitrates and that of barytes, decomposed by charcoal, do not produce the same effect. *Giorn. de Fis. &c.* 1824. p. 240.

For the Destruction of Insects.—Put into a sugar hogshead a small barrel of tar, pour upon it a pail or two of boiling water, stir it, and then fill it up with cold; with this, water the ground where the bushes stand, and it will destroy all worms, grubs, and other larvæ, which are within a considerable distance of the surface of the soil. Should any escape, and make their appearance in the caterpillar state, immediate recourse should be had to a strong infusion of bruised elder tops or leaves, the moment the elder becomes green: this will effectually check the advance of these and all other insects upon the bushes. March is the proper month for watering the ground with tar-water. April is the time to wet the branches frequently with the elder liquor; for, during March, the larvæ remain in the ground, and in April and May they change into the caterpillar state, when they may be seen ascending in small groups the stems of the bushes, spreading themselves afterwards gradually over the whole tree.

Subterraneous Passage of Lightning.—On the 28th May, 1824, a tree in Vernon, Connecticut, was struck with lightning. After passing down the tree, and tearing up the earth at its root, the electric fluid passed "50 or 80 feet under the surface of the earth without following any such substances as commonly guides its course there, as roots, stones, &c. The fluid seems not to have been guided at all by any attracting substances, but to have been carried forward nearly in a straight course by a momentum it had received, through a medium opposing the most powerful resistance, a medium in which it is commonly supposed to be dissipated and lost." The electric fluid left unequivocal traces of its passage through a distance of nearly 50 feet. Through the distance of other 30 feet there can be no doubt of its having passed, as its effects upon a wall were distinct at that distance; and it cannot be supposed that it came out of the ground and leaped 30 feet to the wall. This account is given by Professor Kellogg, in Professor Silliman's *Journal*, vol. ix. p. 84,—86.

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A Committee of Civil Engineers and Practical Mechanics.

"What stubbing, plowing, digging, and harrowing is to land, that thinking, reflecting, examining is to the mind.—*Berkley.*

No. CXXVI. *Saturday*, 20*th May*, 1826. Price 3*d*.

LIEUTENANT LINDSAY'S MARINE CIRCUITOR; METHOD FOR EXPELLING FIRE DAMP FROM COAL MINES.

Fig. 1.

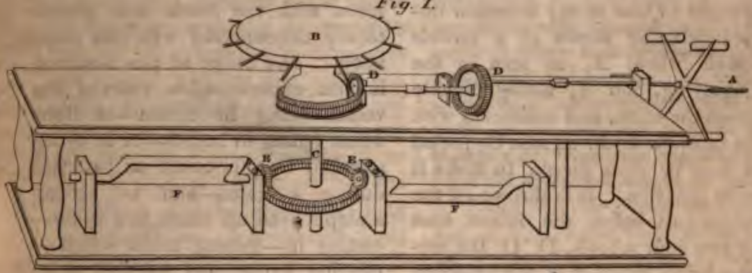
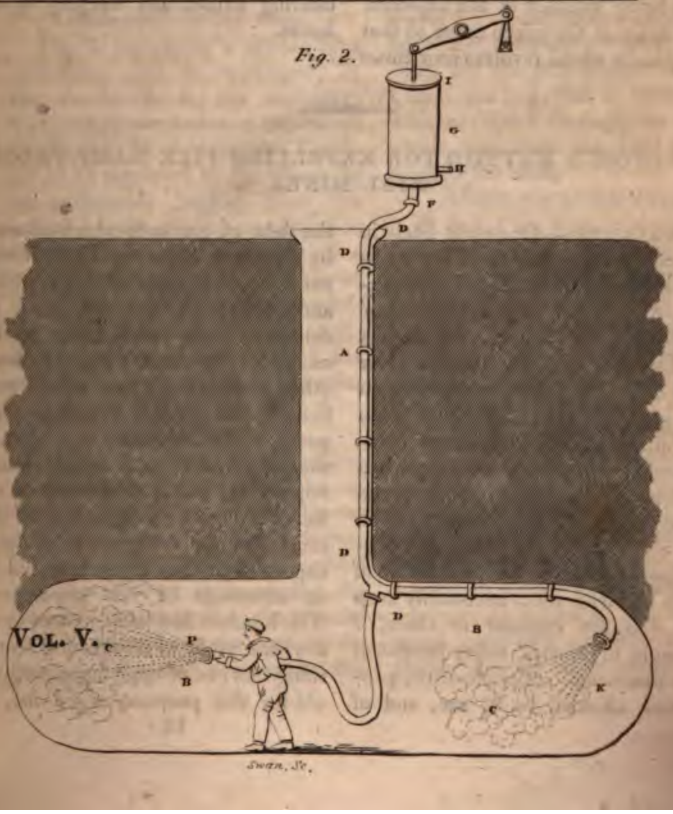


Fig. 2.



Swan, Sc.

Vol. V.

MARINE CIRCUITOR.—INVENTED BY LIEUT. GEORGE LINDSAY.

[We have been favoured, through the kindness of the learned professor of Chemistry in the Andersonian Institution, with the use of the model of this machine, (furnished by the inventor,) for the purpose of giving a drawing and description of it in our work.—*Eds.*]

THE intention of this machine is to enable a ship's broad-side to be brought to bear in any direction immediately, by means of a verticle paddle wheel A, as seen in the Engraving, fig. 1, acting directly across the stern, and connected with the capstern B, by an axis C, joined in four or more pieces, to make it more portable. It is thrown off the centre just before the mizen mast by two spur wheels, D, D, the motion being doubled at the capstern, and again at the mizen mast, so that the paddle wheel revolves four times for once of the capstern. The paddle wheel is in three pieces for the convenience of shipping and unshipping, and making it more easy to stow. In case of the capstern being shot away or damaged, it is proposed to be worked in the cockpit with a tooth and pinion wheel E, with winches, F, F. In frigates and in merchant vessels, it would be advisable to work it in the gun-room with the tooth and pinion totally unconnected with the capstern. The utility of this machine is most experienced in cases of the vessel being in action—in light winds falling in action—or in being attacked by gun-boats or batteries during a calm—and in getting a ship's head off shore in a calm—casting in—getting under weigh—clearing hause, and keeping open hause.

PROPOSED METHOD FOR EXPELLING FIRE DAMP FROM COAL MINES.

GENTLEMEN,—One night lately in my cogitations on some of the truths I had heard propounded and explained in the Glasgow Mechanics' Institution this winter, the subject of Fire Damp in Coal-mines came into my head. After ruminating on the explosive nature of this gas—on the many dreadful accidents occasioned by its destructive energy when ignited, through the ignorance and carelessness of workmen—and on the constant apprehension and uneasiness in which the probability of such accidents must necessarily keep all who are exposed to them, I thought of Davies' safety lamp—of the extent and *rationale* of the protection afforded by its use, and of the debt of gratitude which all owe its ingenious inventor. But if the necessity of the use of this contrivance could be obviated, and of course, all the precautions of its adoption dispensed with, by some other means, and these means sufficiently simple for practical purposes, and by which an explosion of the gas would be rendered absolutely impossible, and if this could be effected altogether independent of the caution of the workmen in the management of their light, it would be an advantage of vast importance. The honour, and (if there was to be any) the profit of discovering something new, or of applying something old for this purpose, urged me, in my meditations, to revolve the subject. The result of which, I now very respectfully submit to your better judgment, and that of the Coal Masters of our country. Their interest, it is obvious, will be very much promoted by some plan, such as the one now to be submitted. But I must first observe, it is so exceedingly simple, and of such easy application, and at an expense so trifling; indeed, so much so does it appear to me that I am afraid I have overlooked some very material consideration, either as to the nature of my plan, or that of the gas to be got rid of, otherwise, it astonishes me beyond measure that some one better informed on the subject, and more interested in such matters, has not long since put something of its kind in practice: however, it is the following, and if there is any thing wrong, tell me. I mean well at any rate.

Description of the Plate.

Fig. 1. represents a section of a coal-mine, and its workings. A the shank; B, B, the workings; C, C, an accumulation of fire damp; D, D, D, D, a pipe (the diameter to be regulated by the labour to be performed) leading from the mouth of the pit, to any situation below that may be required; F a valve opening downwards; G an air-tight cylinder, dimensions according to the necessities of the case); H a valve opening inwards; I the piston which may be wrought by the engine that lifts the water.

Explanation.

The piston, when raised, produces a vacuum in the cylinder; the air from without then rushes in by the valve opening inwards, and by the piston, when forced down again, (which will require very little power,) the whole of the contents of the cylinder will be thrown into the pipe by the valve at F opening downwards, and thence carried to any part of the workings below, as seen in a straight line at K and P.

Here then by this simple apparatus you can throw down any quantity of fresh air you please; or that may be required to dissipate the vitiated air below, by which means this will be kept as fresh as that at the mouth of the shaft.

As to the distribution of the pipes, this will depend on the position and extent of the workings, on the supposition that any part of the workings is charged with fire damp previous to the introduction of the pipes to where it is situated; it can be deluted and expelled, by making a flexible tube bear upon it, as shewn at P, in the way our firemen discharge water from their engines; perhaps the same end might be gained by means of an air pump, raising the foul air from below, through the pipe D, D, D, D, the place of which would be immediately occupied by fresh air descending through the shaft, but the plan suggested above I think the best, that of forcing the fresh air down through the pipes, which will blow the bad air up through the shaft.

Advantages of this Plan.

If then I am right in my conjecture, this constant circulation of fresh air under any circumstance will render an explosion of fire damp impossible; and for this plain reason, by the use of the means just explained, the gas will never be allowed to accumulate to an explodable quantity, but will be completely deluted and blown off as it generates. It will require scarcely any power to throw as much air into the remotest corner of the workings as may be deemed necessary. It will require no caution on the part of the workmen to insure its success, and must contribute greatly to their health, the air being always fresh, besides saving their lives, and freeing them from the painful apprehensions, arising from the possibility of such fatal accidents as have often happened with this gas, through their own inattention.

J. B.

Glassford Street, 27th April, 1826.

P. S.—By the subjoined figure, I would not be understood as laying before you the only or the best way of applying the principle I have suggested. There may be many ways in which the apparatus may be distributed; these I leave to practical men, and shall be highly gratified should my principle meet with their approbation.

EDINBURGH SCHOOL OF ARTS.

Dr. Fyfe closed his course of Chemistry last Wednesday, with an interesting lecture on Galvanism, in the course of which he explained the nature and use of the protectors now attached to the copper-sheathing of ships, to prevent their corrosion. After the lecture was finished, Mr. John Dunn, optician, Thistle Street, in the name of the students, presented Dr. Fyfe with an elegant and costly time-piece in the form of a Doric portico resting on a variegated marble base, and bearing the following inscription:—"To Andrew Fyfe, M. D. F. R. S. C. &c. from the Students of the Edinburgh School of Arts, in testimony of their esteem for him as an instructor in Chemical Philosophy, and of their gratitude for his disinterested zeal in behalf of the institution. Presented at the close of the Session of 1825–6."

PRIZES FOUNDED BY PROFESSOR ANDERSON.—CATALOGUE OF HIS WRITINGS, &c.

Gentlemen,—The sketch of the life of Professor Anderson, given in Appendix to III. Vol. of your Magazine, was drawn up in a great hurry, and consequently many circumstances regarding him omitted: I now beg leave to add the following.

The Professor was the founder of a Prize to be given annually in the College of Glasgow, to the Masters of Arts for the best Essay in Physics, and, if I am not mistaken, the late Professor Arthur was the first successful aspirant; the subject was the circulation of the blood. The prize was a Silver Medal, with the following inscription, EX DECRETO M. A. UNIVERS. GLASQUENS. And in the middle a white Enamel head of Cicero, the Roman Orator, by the celebrated James Tassie; on the reverse PRAEMIUM PHYS. JOAN. ANDERSON DONAT, with an oval field for the successful candidate's name to be engraven on, and to this was added a purse of ten guineas. He also founded at this time a similar prize to the Masters of Arts, for the best specimen of Elocution, the same medal and inscription, but a white Enamel head of the celebrated Greek orator, Demosthenes, and on the reverse PRAEMIUM ELOC. JOAN. ANDERSON DONAT; to this was also added a purse of gold. These medals with the dies for the silver frames, cost a great deal of money, and are quite complete in all their parts, and are contained in a mahogany box among the other articles in his Museum. There are a number of silver coins of the Roman Emperors in good preservation, and a gold coin in perfect preservation of Antoninus Pius on one side, and on the reverse his wife Faustina. These coins were all found on the Roman wall between the Forth and Clyde. They were offered to the Faculty of the College, along with two other very important Legionary *Stones*, if they would place the whole of the Roman Altars, Legionary Stones, &c. which they had already procured, in a proper dry place in the new Library, but it was refused; and even the memorial making the request was refused to be inserted in the College Record. One of the above stones was found in a field near to the Piel of Kirkintilloch, and accounted for the six miles of the wall that was wanting. The other was found in the ditch of the Barhill Fort near Kilsyth, one of the largest Roman Forts in Scotland. In said Museum are contained the following unpublished Manuscripts, some of which are ready for the press, and I have little doubt, if printed, would be productive of great profit to the Institution, or a sum might be got for the copy-right from the Booksellers, they are as follows:

1. An Essay on Evidence.
2. Concerning Scots, English, and Irish Idioms.
3. Of the Roman Wall between the Forth and Clyde, and of some discoveries lately made upon it.
4. Of the propriety of erecting a *Monument in honour of George Buchanan.*
5. A cheap and speedy plan for increasing the power of Artillery without increasing the size of the Guns.
6. Oratio mea Inauguralis when made Professor of the Hebrew language.
7. Of Pronunciation.
8. Remarks on Hume's Essays.
9. An Enquiry whether all the knowledge in natural Theology to be found in the world has arisen from Revelations, and not from the natural powers of human nature.
10. Remarks on the Poetical remains of James I. King of Scotland.
11. Letters on Weights and Measures. This is a subject quite in point at the present moment, and I have little doubt will shew, although written upwards of 30 years ago, that he understood the subject well.
12. An Essay on Mail Coaches.
13. An Essay against Lord Kames.
14. Questions in the Literary Society of Glasgow College.
15. Of the Barometer and Barometrical Mensurations.
16. Of the moisture in houses that are situated on prominent rocks.
17. An Humourous Essay on *Love*, in the Stile of good John Bunyan.
18. Of the varieties in the human kind.
19. On rain gages and rainy climates.
20. An Enquiry whether mankind have run into greater absurdities where religion is concerned than where it is not. This will be found a most interesting Essay.
21. Letters concerning the Rotation of the Moon on her axis.
22. Correspondence with the Duke of Richmond master General

of the Ordnance concerning the Professor's new-invented field Artillery. This correspondence is completely ready for printing.

3. A Letter to the Right Honorable William Windham Secretary at War, in January, 1795, concerning the use of his new Artillery on the Dutch dykes in defence of Holland against the French. The noble Secretary was the pupil of the Professor, and was a lodger in his house, at Glasgow College. This letter is written with great freedom, and contains many political predictions that may soon be verified.

These Manuscripts contain many most interesting articles, some of them new, and written in that perspicuous manner, peculiar to the Professor, and ought not to continue longer to be buried in the locked presses of the Museum of the Institution.

In the last year of his life, he published a new edition of his Institutes of Physics, a useful book of 500 pages, but now however little known. When the last proof sheet was brought to him from the printing office, he said, thank God this is finished, when I am almost finished myself. It was his custom to go early to bed, and to rise at five o'clock in the morning summer and winter. On the 13th January at noon, he departed this life in that slow and gradual manner, without pain, or motion, that he might be said to have slipped out of the world, without knowing it.

J. P.

GLASGOW MECHANICS' INSTITUTION.

Conversation Class,

ESTABLISHED THIS WINTER BY MR. DEUCHAR.

We are happy to have it in our power to state that the most flattering success has attended Mr. Deuchar's efforts in establishing a class for conversations on Chemistry and Mechanics. Although the members who have availed themselves of this opportunity of acquiring useful knowledge have never exceeded fifty, yet a general enthusiasm has been diffused amongst those who have attended.

The Committee of the Institution during their various visits at the examinations of the class, were so satisfied of the utility of this method of instruction adopted by Mr. Deuchar, and which we understand is the same he has followed for the last twelve years in Edinburgh, that they assigned ten of the Institution Premiums to the most zealous individuals who attended, and to these Mr. Deuchar himself added a copy of the Glasgow Mechanics' Magazine, Four Vols. and of the London Artizan, Two Vols. as two separate rewards.

The correct and acute observations made by almost the whole of this Scientific Group, every one vying with another in zeal for instruction, has surprised the occasional strangers who have stepped in. At the close of the season, they met to award the prizes, and the following is the result; they voted Mr. Deuchar's first Premium, as the first reward of Merit, to Mr. **WM. FAIRSERVICE**, jun., 421, Gallowgate.

The first Institution Premium, as the second reward of Merit, to Mr. **JAMES SYME**, jun., Taylor Street.

The second Institution Premium, as the third reward of Merit, to Mr. **JOHN M‘LEOD**, 28, Guildry Court.

Mr Deuchar's second Premium to Mr **JAMES SYME**, jun., for the satisfactory and regular manner in which he fulfilled his duty as assistant at the Lectures of both classes.

The other Premiums for regular attendance and promptitude in answering the questions put to them, were given to

W. Pattison,	Dunn's Work—Two.
T. Peddie,	Dunn's Work.
Matthew Craig,	24, Rose St. Hutchisontown.
J. Walker,	Harvie's Land, Port Dundas.
J. Petsie,	Do.
W. M‘Kever,	Do.
Neil M‘Lardie, Saltmarket,—Two Premiums.	

Since the above adjudgment of prizes, the Conversation Class has drawn up and read to the Institution, a Report (which we will publish next week) narrating their proceedings, and expressive of their gratitude to the Committee of management, and to Mr. Deuchar, for the advantages they have allowed them this winter, of having the subjects of the Lectures impressed upon their minds by means of a class for Conversations.

At the close of the last Lecture of the Session, on Saturday, 13th May, the Conversation Class met for the last time;—and in a short, but energetic address, returned their thanks to their teacher for his instructions; stated that several of them, who had been members from the establishment of the Institution, had never till they attended these conversations known the true value of instruction; and they also conveyed the gratifying information that they had formed themselves into a Society to meet during the summer, for mutual instruction and practical investigations, in Chemistry and Mechanics.

PROPERTIES OF MATTER.

MATTER, in common language, is a word of the same import with *body*, and denotes that which is tangible, visible, and extended; but among philosophers it signifies that substance of which all bodies are composed; and in this sense it is synonimous with the word ELEMENT.

It is only by the senses that we have any communication with the external world; but the immediate objects of sense, philosophers have, in general, agreed to term *qualities*, which they conceive as inhering in something which is called their *subject* or *substratum*. It is this substratum of sensible qualities which, in the language of philosophy, is denominated *matter;* so that *matter is not* that which we immediately see or handle, but the *concealed subject* or *support* of visible and tangible qualities. What the moderns term *qualities* was, by Aristotle and his followers, called *form;* but so far as the two doctrines are intelligible, there appears to be no essential difference between them. From the moderns we learn, that body consists of *matter* and *qualities*, and the peripatetics taught the same thing, when they said that body is composed of *matter* and *form*.

LEITH MECHANICS' INSTITUTION.

The first general meeting of the Leith Mechanics' Institution was held in the Exchange Sale-Room, on Friday the 5th of May, for the purpose of receiving the report of the interim committee, constituting the Institution, and adopting regulations. The meeting was very numerously and respectably attended; H. Johnston, Esq. in the chair. By the report of the Committee, which was read, it appeared that the subscriptions by 102 subscribers amounted to upwards of £145. Donations of books, exceeding 100 volumes, on the most important branches of the arts and sciences, with some valuable maps were announced. In addition to these subscribers, who are also members, 153 mechanics and others have put down their names as members. This, we think, considering how very recently the scheme has been agitated, augurs well for the ultimate success of this valuable institution. The zeal evinced by the mechanics of Leith for the acquisition of useful knowledge, (for the scheme originated with themselves,) and the prompt assistance they have received from the Magistrates, and many of the most respectable gentlemen of the town, is alike creditable to all parties; but, though much has been done, much remains to be done before the institution can be established on such a basis as to make its usefulness felt to the extent of which it is capable. We hope and trust then that the institution will receive from all ranks that support to which its merits so well entitle it. It will reflect no little discredit upon the important port of Leith, if the only institution established within it, for the instruction of its numerous population, in scientific knowledge, be suffered to languish for want of support; but of this we have little fear. The plan of the institution is liberal, and seems well adapted to the objects in view. The trifling payment of 12s., and half that sum for apprentices, will enable the members to reap advantages little short of the students attending the classes of the Professors of Mathematics, Natural Philosophy, and Chemistry, in any of the Universities, with this addition, that after having attended the lectures for three or four years, members are to be entitled for life to the use of the Library, upon payment annually of the merest pittance. To the great body of mechanics, clerks, and shop-keepers, whose avocations necessarily preclude them from such branches of education otherwise, this institution cannot fail of being useful in a very eminent degree.

BELFAST MECHANICS' INSTITUTION.

At a General Meeting of the Members of the Institute held, Mr. Samuel Archer, Secretary, read the Report, in which the directors regretted they could not report an increase of members. Some having withdrawn from unsteadiness or insensibility of the advantages of the Institution—the depressed state of trade also prevented many from joining it. Although no learned men have come forward to express their fears or disapprobation of it, yet there has been a chilling coldness manifested, and some mistaken notions entertained that it might foster a spirit of combination, and diffuse infidelity and scepticism among the working classes: these apprehensions the Report very ably, though briefly, endeavoured to dissipate, and dwelled on the positive advantages which the spread of knowledge was calculated to produce, rendering social life more endearing, political obedience consistant, lessening the bitterness of adversity, augmenting the pleasure of every laudible gratification, and, as its brightest influence, becoming an avenue and a guide to "that Temple which is not made with hands eternal in the heavens."—The example of our illustrious Sovereign, and his liberal and enlightened Cabinet, was then referred to, as distinguished examples of patronage to Mechanics' Institutes; and the eagerness which had been already manifested to obtain knowledge, by the Pupils of the Scientific School, the demand for books at the Library, and the attention at Lectures, as calling for an extended Library, a collection of models and instruments, and a more suitable lecture and school-room. The Library, which is increased by purchases and presents, now consists of 396 volumes, of which 120 are generally out at one time; the library-room is open twice-a-week for reading and exchanging volumes, and the attendance is orderly and numerous. The Lectures of Professor Stevelly, now in course of delivery, have been rendered more instructive, by large drawings on muslin 12 by 10 feet; after the course is finished, the Rev. J. Bryce will commence his purposed Lectures on Geography. Very little progress has yet been made in procuring apparatus or models. Respecting the funds the Report states, that there is now £525 at interest in the Commercial Bank, for the purpose of building, or otherwise advancing the interests of the Institute. The number of members who have paid is 200; £150 of the sum originally subscribed remains unpaid. The Report, after again adverting to the necessity of having more suitable rooms for the Institute, concludes by calling on the members to exert themselves in promoting its various objects, bearing in mind that, "in proportion as men are rendered intelligent, they will become virtuous, prosperous, and happy."—The Report was unanimously adopted.

New Directors—Messrs. C. B. Grimshaw, Geo. Handman. Edm. Getty, Arthur Hill, Thornton. *Operatives*—John Braddell, gilder; Henry Greer, book-binder; George Banson printer; Patrick Gaw, cabinet-maker; Robt. Ireland, brazier; John Connor, carpenter; Patrick Law, brass-founder; John Murphy, stone-cutter.

[We regret much to perceive from the above Report, that indifference have been manifested towards an object so laudable and praiseworthy as this Mechanics' Institution, and sincerely do we trust our friends in the sister Island will not be discouraged in their exertions but establish it on a firm and permanent footing. They do well in the election of their directors to have a portion of the operatives brought in. While this plan is adopted, there is but little danger of the Institution going down altogether; and by the time it is of age, and once they have sufficient funds of their own to rear an establishment fit for their purpose, the good work will proceed to go on of itself to the utmost of their wishes. It only wants a firm foundation to begin upon.—*Edits.*]

DESCRIPTION OF THE METHOD OF CASTING BRONZ STATUES.

GENTLEMEN,—In a former number you gave us a few remarks on the difficulty of casting bronze statues; this you illustrated by the blunders which the founders committed who made some of the many bronze casts which adorn Paris. With your leave, I will follow up this with a description of the method adopted by some of our founders, and if any of your numerous readers will favour the trade with a better, he will confer a benefit on the arts.

After the artist has finished the model of the full size, he takes a mould of it in stucco; the separate pieces of this mould must be of such a size and form, as to part freely from the model.

The outside of this mould is now smoothed down, and that they may the more easily be put in their proper places again, each part has a number cut on the back of it; these are now oiled, and a cast is taken off the outside of them: this large outer case is made to part asunder in two pieces if the figure is not very large; the numbers cut in the back of each small piece will have made a corresponding mark on the inside of the large outer case; this enables the artist to place the parts in the outer case as he takes them from the model.

Let us suppose that the whole parts of the mould are placed in the two outer cases as they ought to be, so that if the two were put together, they would be a mould fit to cast a solid figure: but this is not what is wanted, and a mould of stucco is only fitted for casting wax or stucco figures, as it will not stand hot metal, therefore, the artist lines the two half moulds with a sheet of wax of the thickness that he wants the metal to be, taking care that the wax is pressed properly into the mould that it may have a complete impression of it; the edges of mould are smoothed that they fit one another.

The whole is now filled loam to form the core, having per vents left to convey out th that may arise from the h metal acting on the core. core is also supported by h bars of iron laid into it bent the form of the figure; the halves are now joined and whole set on end; the outer c now taken off from the mould each of the smaller pieces ren from the wax. Corrections are made by the artist on this figure.

Long pincels of wax are att to all the parts of the figure which the air will require t taken, these are connected wit vents.

The founder now commenc coating over the whole with he intends to be the inner surf his mould, which is generally water, and powdered-charcoal; is applied after the first coat i and increased in thickness enough has been applied; the is now built round with bricl strongly bound with screw-h to prevent the mould bursting the weight of the metal.

The whole is now dried small fires placed round and it; after a short time, these fir increased to melt out the which runs into vessels plac receive it. When the wax out the fires are increased unt mould is heated to redness; i requires to be treated the sar any other loam mould, that i into a pit and the sand rammec all round it to prevent the pos ty of the metal either burstir otherwise making its escap the mould; the core must well secured in its place, to prevent it from shifting or being buoyed up by the fluid metal.

After the metal has been run into the mould and cooled, the outer materials of the mould are taken off, and the surface of the figure cleaned, the artist resumes his labour by cutting off the gates, vents, &c. making good any deficiencies by indenting, pining, and pairing away any roughness until it is complete in all its parts.

This patching is required more or less in almost all works of this kind. In the pillar Vendome which you have taken notice of in your CXXII No., this patching is carried a great length. In the pedestal on which the statue of Buonaparte formerly stood, many pieces have been indented, some of them as large as a page of your magazine, and this pedestal which forms the lantern is but a plain cylinder with a door in one side, the rest of the parts of the pillar are too far from the eye for minute inspection, but all that you can get close to bears marks of it.

Perhaps the following description of this immense piece of bronze work may entertain some of your readers. The description is partly from memory; the measurements and what cannot be obtained by inspection is taken from the Guide to Paris. I believe the whole will be found pretty correct.

The triumphal Column of the place Vendome stands in the centre of a square, about 420 by 450 feet, on the very piles where stood the pedestal of the statue of Louis XIV. that was thrown down at the Revolution: this monument is an imitation of Trajans Column, but on a scale $\frac{1}{12}$ larger; it is 133 feet high from the ground to the very top, the column is about 12 feet in *diameter; the pedestal is about 22 feet high, and from 17 to 20 feet in* breadth; the found is about 30 feet under the surface; the platform is composed of three steps of white marble, each 4½ inches in height; the pedestal and column are entirely covered with low reliefs in bronze, formed out of brass cannon taken from the Russian and Austrian armies in the campaign of 1805. The pedestal is covered with trophies of war. Above the cornice at the four angles are four eagles, the cornice has a garland of oak leaves such as is on Lord Melville's monument in Edinburgh; there is a bronze door on one side of the pedestal richly decorated; above the door is a plate supported by two figures on which was the inscription, but it is now filed smooth.

The emblematic figures that forms a band, making 22 revolutions round the shaft, were traced by Berzent, and were executed by 31 sculptors, one of whom was a female *Mlle Charpentier;* the plates that cover the shaft are about 3 feet, by 3.8 inches high; there are 276 plates joined at the lower and upper edge by a spiral garter, on which was the inscription relating to each action, the plates representing this band is about 3 feet broad.

We get to the top of the column by a stair of 176 steps, each 20 inches broad and 7½ deep; this stair terminates in a lantern 15 feet high and about 9 feet in diameter; this is again surmounted by a dome about 6 feet high, on the top of which was a statue of Buonaparte 10 feet in height, which weighed 5112 pounds; it is now a white flag that terminates this monument; around the lantern is a balustrade of 3½ feet in height, forming a gallery on the top of the albacus; from this you have a most extensive view, it being nearly in the centre of Paris.

Great care was taken in joining the brass to the stone to allow for expansion; each plate, if I understand it correctly, is hung to the stone by hooks allowing as much play as was required for expansion; the hooks being in the bosings of the reliefs, which allowed the plates to fit close to the stone. This stone is the hardest that could be procured and made quite smooth that there might be no jambing between the brass and it, there is 1.800.000 pound of bronze on this column; the produce of 1200 pieces of cannon, the expence of this monument was £63,000.—I am, Gentlemen,

Your's, truly,

Robert Hart.

MISCELLANIES.

Cure of a Deaf and Dumb Child. A boy ten years old, who had been completely deaf from his infancy, was cured by M. Deleau, a Parisian physician, by a method which has been tried with success before, the forcible injection of air into the cavity of the tympanum through the Eustachian tube. The particulars of the operation are not given; but it appears to have been accomplished without causing any inconvenience, and has proved completely successful. The developement of the voice has been very gradual and difficult, and attended with many very singular phenomena. Before the operation he could not hear any noise, however violent; his countenance was dull, his gait sluggish, and his manner stupid. On the restoration of his hearing he testified great delight, took great pleasure in listening to all kinds of sounds, and was thrown into ecstasy by a musical snuff-box. It was long before he had an accurate conception of the direction of sounds. He very soon began to imitate simple sounds with his voice, such as the vowels a, o, and u, and words containing them, such as *papa tabac du feu*; but the more complicated sounds cost him great effort, and he succeeded in pronouncing a few of them, not without extraordinary contortion of all the organs of speech. Very little progress was made in teaching him pronunciation by the sounds merely; but with the aid of the written signs he advanced much more rapidly. He has now been a year under tuition. "He can distinguish the characters of various sounds, knows when they come from a distance, avoids carriages and horses, opens the door when any one knocks, *can appreciate* musical rhythm, knows *all the sounds of his* language, can repeat by memory a certain number of easy phrases, and even reply to them, and finally executes by speech whatever his preceptor orders him." It is a curious circumstance, however, that he still continues to use signs only in communicating with other people on ordinary occasions; nay, instead of being gradually replaced by speech, his language of signs has become much more perfect and expressive. He entertains a profound contempt for the deaf and dumb children with whom he used formerly to associate.—*Journal de Physiologie, Juillet* 1825.

Treatment of Poisoned Wounds by the Application of Cupping-glasses.—At the meeting of the Royal Academy of Medicine of Paris, on the 9th of August last, Dr. Barry, an English physician, resident in the French metropolis, read an account of some experiments on the effect of applying cupping-glasses to poisoned wounds. According to Dr. Barry, if a mortal dose of strychnia, or hydrocyanic acid, the most deadly poisons with which we are acquainted, be introduced into a wound after the blood has ceased to flow, the usual effects will be prevented as long as the suction is kept up; nay, if the cupping-glasses be applied after the symptoms of poisoning have commenced, the animal will recover. A committee of the Academy was appointed to witness and report on the experiments of Dr. Barry; and their report confirms all his statements. The following is an abstract of the most remarkable experiments: Eight grains of arsenic were introduced into a wound in the thigh of a dog. In four hours he was very ill; and he died in fifteen hours. On another dog, under the same circum-

a cupping-glass was applied 45
s after the arsenic, and in four
here was not the slightest appear-
ailment. Six drops of diluted
yanic acid, containing $1\frac{1}{2}$ of the
id, were dropped into a wound
bbit, and a glass applied immedi-
fterwards. In twelve minutes,
ptom of poisoning having appear-
glass was taken off. The ani-
s immediately seized with violent
sions, and soon appeared dead.
ved on the re-application of the
g-glass. After twelve minutes
ad elapsed, the glass was again
ff, and the same symptoms recom-
l. On then applying it twelve
s longer, it was withdrawn per-
ly, and the animal recovered.
it poisoned under the same cir-
nces, without the application of
ping-glass, died in two minutes.
ain of the upas-tieute was thrust
to a wound in a rabbit, and a
g-glass applied immediately. The
were analogous to those obtained
e hydrocyanic acid. On two
ns, half an hour and three-quar-
n hour after the introduction of
son, the removal of the cupping-
as followed by the appearance of
culiar symptoms of poisoning
ychina; and each time the symp-
ceded when the glass was re-

Dr. Barry thinks these experi-
rove, that not only the absorp-
the poison is prevented, but like-
at is absorbed previously to the
tion of the cupping-glass is
wn from the circulation; and
ave seen in them a proof that
poisons, previously supposed to
ugh the blood, really act through
of the nerves. In our opinion,
supposition is well-founded. It
d to talk of poison being drawn
wound after being distributed
the whole circulating mass of
d; the symptoms disappear, be-
hat is absorbed is either excreted
mposed, and because, farther ab-
being prevented, the poison
accumulate in sufficient quantity
e fatal. By intermissions in the
ion of the glass, the whole poison
bed in separate small portions,
charged from the system in like
; so that the symptoms do not
dangerous in degree. Barry's
ents, so far from upholding the
e of poison acting by nervous sympathy, appear, in our opinion, to disprove it. We can easily understand how the suction caused by cupping-glasses will prevent absorption. We cannot, on the other hand, perceive how it could prevent the poison from lying in contact with the nerves, which is all that can be requisite to produce the necessary impression. These experiments are deeply interesting, and, in a practical view, highly important.—*Archives Generales de Medecine, Septembre & Octobre*, 1825.

Jefferson County Salt Spring.—This spring was discovered by a farmer in Ellisburgh, who was digging for water for his cattle, during the late drought. After excavating the earth to the depth of six feet, he struck upon a lime stone rock. Having bored this to the depth of three feet further, the drilling iron gave, and on pulling it out, it was followed by a water spout which rose to the height of twenty or thirty feet. Discovering the water to be strongly impregnated with salt, he plugged up the hole, and went home for buckets, in order to taste its quality. Evening came on before he returned to the well with his son, and a lanthern to light their path. On pulling out the plug, however, what was the old man's astonishment (not being acquainted with gases) to find, that instead of water, a volume of air rushed forth, which caught fire from the candle, and for a moment enveloped father and son in a sheet of flame. The column of water, however, soon followed, and immersed them in a different element much more cooling and agreeable. The fountain continued to flow, and five buckets of the water were boiled down, and yielded three quarts of salt. This is not quite so great as that of the Salina spring, but the water flows in abundance, and is considered sufficiently strong to make the manufacture of salt valuable to a company which has hired the premises for ten years. A gallon of the water weighs 9 oz. Avordupois more than common water.—*American Spectator.*

Brewster Wool Spinning Frame.—The following notice of this ingenious invention is given by S. D. Hubbard, Esq. of Middleton, Count. in a letter written in answer to inquiries from Professor Silliman.

The Brewster Frame deriving its name from the inventor, Mr. Gilbert

Brewster, a distinguished mechanist and native of this state, is so constructed that by the continued rotary motion of the main shaft to which the moving power is applied, all the operations that are performed by the hand on the single domestic wheel of drawing out, twisting, and winding up the yarn to form the cap are perfected, leaving to the attendant no other labour than that of joining the threads, as they may occasionally break. The direction of the draft being vertical, the frame occupies not more than one sixth of the space required for jennies doing the same amount of work, and enables the attendants to mind the threads with much greater convenience. The length of the draft or quantity of slubing to be drawn out, and the time of throwing in, and continuing the twist being comprehended within the principle of the frame, they may be varied at pleasure. It is only necessary for the attendant, after ascertaining the description of yarn she is wished to spin, whether fine or coarse, hard or slack twisted, to adjust the frame with a wrench to the quality, shortening or protracting the period of the closing of the jaws on the slubing, as she may wish at finer or coarser, varying the time of carrying on and off the belt from the twisting cylinder, according as she may desire her yarn hard or slack twisted. When once adjusted, the frame continues in the same state, producing a uniform thread, and possesses the additional advantage from its mechanical construction, and the uniform regularity of its movements of furnishing, if required, a thread slacker twisted for filling, and for warp one harder twisted than can be spun on a jennie; the expence of keeping a frame in repair, and the power necessary for its successful operation are not greater than is required by power jennies, doing the same work. A frame of 300 spindles, also, will spin 300 runs 1600 yards to the run per day, and will with ease turn off 100 lbs of four run yarn in twelve hours. Two girls of 16 years of age will attend a 300 spindle frame, one on each side.—*American Paper.*

Indian Method of twisting Iron for Gun-barrels, &c. By CAPTAIN BAGNOLD.—The gun-barrels made at Bombay in imitation of those of Damascus, so much valued by the Orientals for the beauty of their twist, are manufactured
from iron hoops obtained from
pean casks, mostly British. The
these hoops are corroded by rust,
are proportionably acceptable t
workmen; should there be any de
cy of this necessary oxidation, th
regularly exposed to moisture unti
are sufficiently prepared for we
Being cut into lengths of about
inches, they are formed into a p
inch and a half high, laying the
straight so as not to overlap each
a larger piece is then so fitted as
turn over each end, and hold the
together in the fire. This pile is
heated, and drawn out into a
about one inch wide and one-third
inch thick; it is doubled up in th
more lengths, and again drawn
before; and this operation is re
generally to the third or fourth
according to the degree of finene
quired. The bar is then to be
about one-third of its length at a
and, being struck on the edge,
tened out the contrary way to that
stratification. This part of the
tion brings the wire or vein out
upon the strap. The barrel is
forged in the usual way, but much
jumping is used than in the E
method, in order to render the tw
er. The most careful workmen
make a practice of covering the p
posed to the fire with a lute
posed of mud, clay, and the d
cows or horses, in order to guard
any unnecessary oxidation of the
When the barrel is complete, the
raised by laying the barrel from
five days either in vinegar or a s
of the sulphate of iron, until th
is raised: this process is called th
twist. To produce the curl, the
straps are drawn out into bars
three-quarters of an inch squar
twisted some to the right and ot
the left, one of each sort is then
together, doubled up, and drawn
before; and upon the experience
workman, any intricacy of twist
duced by this drawing out, do
and twisting.—Sometimes, to sav
ble and economize iron thus pr
the artist will rough-file an Engli
rel, weld a strap of Damascu
spirally round it, or several a
longitudinally, and welded on.
tive artist never works with coal
any consideration. Char-coal fro
woods forms his only fuel.—In

the sword-blades, there are several used; some make a pile of alternate layers of soft hardened steel, with powdered cast iron mixed with borax sprinkled between each layer. These are drawn out to one-third more than the length of the intended blade, doubled up, heated, twisted, and re-forged several times; the twist is brought up in the same way as that in the gun-barrels.—Some swords are forged out of two broad plates of steel thus prepared, with a narrow plate of good iron welded between them, leaving a solid steel for the edge of considerable depth. Others prefer making them of one plate of steel, with a lamina of iron on each side of it to give strength and toughness. Swords of this description were tempered in my brother's presence in the following compound, and as he states with considerable effect: the blade was covered with a paste formed of equal parts of barilla, powdered egg-shells, borax, salt, and crude soda, heated to a moderate red heat; and just as the red is changing to a black heat, quench it in spring-water. From the information of this workman it appears, Damascus obtains all its steel from the upper part of Deccan, where it is called the *fonlode hind*, or Indian steel, of which there are great quantities, but little or no demand for it. The damasque, or joar, is natural to this steel, and is raised by immersing it in an acid solution.—*Trans. Soc. Arts.*

Quantities of Charcoal and Ashes which are produced by different kinds of Coal.

IRISH COAL.	Charcoal	Ashes
Kilkenny coal	92.8	2.8
Ditto slaty	80.4	6.5
Bonlavooneen	82.9	3.2
Corgee	87.4	3.4
Queen's County, No. 39	86.5	3.1
Scotch cannel	39.4	4.0
ENGLISH.		
Welsh Furnace	88.0	3.4
Alfreton	52.4	2.0
Butterley	52.8	4.2
Welsh stone	89.7	2.3
Ditto slaty	84.1	6.7
Derby cannel	48.3	4.6
Oak Wood	19.5	0.5
Stone wood, Giant's Causeway	54.6	11.9

That is, 100 parts of Welsh furnace coal contain 88 parts of charcoal and 3 4-10th parts of ashes; the loss of 8 6-10th parts in the hundred parts is the gaseous parts of the coal. Those varieties having the most charcoal and ashes, are obviously the most unfit for the production of gas; but the most suitable for smelting, and other similar operations.

Simple tests to distinguish Oxalic acid from Epsom Salts.—Let a few drops of vinegar be mixed with the solution—if it is oxalic acid, its colour will change: if Epsom salts not;—or, dip a silver spoon, or put a sixpence into the mixture: if oxalic acid, the colour of the silver will be changed: if Epsom salts it will not; as it respects the taste, if the tip of the tongue be applied to the solution, the detection would appear at once, without danger, for oxalic acid is *strong, hot, and very sour.* Epsom salts have merely a gentle sort of bitter saltness;—or, dip the end of dark purple paper into the solution; if oxalic acid has been improvidently substituted, the colour of the paper will be instantaneously rendered a *bright red;* on the other hand, in a solution of Epsom salts, it remains *perfectly unchanged.*

Invention.—A Mr. Twichell of Philadelphia is said, by a writer in the United States Gazette, to have invented a clock that will give the time of day, in any part of the world, the time of the moons rising, southing and setting, the exact time of her change, quarter, full, &c.; and what is more, will calculate longitude, and is not much more expensive than a common clock.

Origin of Coal.—Geologists have given great scope to their inventive faculties in endeavouring to determine the source and origin of coal; but every thing tends to show its vegetable origin, and specimens of a regular succession of wood, little changed, and ending with coal, in which all organic traces are lost, have occurred. And even in the most perfect coal some relic is often found, some trace of vegetablet exture, some fibrous remain, that clearly announces its ligneous origin. In the leaves that appear in bovey-coal, for instance, resin and extractive matter have been found, and also a substance uniting the properties of resin and bitumen; and the same substance has been found in the principal coal-field of Staffordshire. Perhaps, therefore, antediluvian timber and peat-bog may have been the parents of our coal strata: but then it will be asked, how has this mighty change been effected? It is merely by aqueous agency,—a kind of decay and rotting-down of the wood,—or has fire been called into action, terrifying the vegetable matter, and the pressure under which it has operated, preventing the escape of volatile matter, caused the formation of bitumen? And are those reservoirs of compressed carburetted hydrogen, from which *blowers* result, to be ascribed to such a mode of formation?—*Panoramic Miscellany.*

Analysis of the Piney Tallow from Malabar.—This curious substance is obtained by boiling the fruit of the *Vateria Indica* or *Piney*, a tree common on the coast of Malabar. The tallow rises to the surface in a melting state, and forms a solid cake on cooling. In this state it is generally white, sometimes yellow, greasy to the touch, with some degree of waxiness, almost tasteless, and has rather an agreeable odour, somewhat resembling common cerate. It melts at a temperature of 97½° Fahrenheit. It is so tenacious and solid, that 9 lbs. of it cast in a rounded form, could not be cut asunder by the force of two strong men with a fine iron wire, and it was very difficult to effect a division of it, even with a saw. Its specific gravity at 97½° is .8965 and at 60° .9260. According to the analysis of Mr. Babington, from whose paper on the subject we have taken these particulars, piney tallow consists of

Carbon	77.0	10 atoms.
Hydrogen	12.3	9 "
Oxygen	10.7	1 "
	100.0	

Mr. Babington remarks that 500 cwt. of piney tallow, may be obtained in the town of Mangalore, for 50 rupees, which is about 2½d per pound. *Quarterly Journal,* No. 38, p. 177.

Cheap, Wholesome, and Savoury Food.—The different Committees for the relief of the distressed manufacturers would do well to promulgate the following recipe:—"Take one pound of East India rice, steep it in cold water for several hours, (or from the night before would do better) then put it into boiling water, and previously steeped enough, it will be sufficiently boiled in about ten minutes; then pour off the water, and dry it on the fire, as in cooking potatoes. Use it with the following gravy or sauce:—Two or three ounces of mutton suet fried with onions until done enough; then add some flour and water (as in making gravy) with salt, and about as much Cayene pepper as will lie on a sixpence; the different ingredients may however be varied to the taste. At the present wholesale prices of East India rice, the above would only cost about threepence, and would be a sufficient meal for a family of six persons."

To make a superior Varnish.—To one quart of good spirits of wine and 6 oz. of acid or shell lac, mixing them together until the gum is dissolved, add 4 oz. of vermillion in powder; again shake the whole until it is well mixed, then let it stand until it settles; the fine Varnish will rest at the top, and be fit for use immediately. When carefully poured off the remainder serves for the same quantity after repeated, or may be used as a beautiful red japan.

If a little Gamboge is added to the fine varnish it will make an exquisite gold colour. If a little Lamp Black, it will make a good black japan.—*Curiosus.*

Iodine Discovered in a Mineral.—M. Vauquelin has found 18½ per cent. of Iodine in the mineral from Mexico which was labelled *virgin silver* in serpentine.—*Ann. de Chim.* xxix. p. 99.

ANSWERS TO CORRESPONDENTS.

Communications received from 'Eliza,'—'W. S. Methven,'—'M. Johnstone,—'A Carver and Gilder.'—The Query of 'J. G.' is inadmissable.—'L. M'L.' was wont to employ his pen more to the point.—The Nuisance complained of is great, but we fear it would serve no good purpose to notice it here.

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THE GLASGOW
MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

> "The Mechanic schools, which are now spreading so widely and rapidly over the face of our land, must be regarded as a mighty contribution to those other causes which are all working together for the elevation of the popular mind."—*Dr. Chalmers.*

No. CXXVII. *Saturday, 27th May, 1826.* Price 3*d.*

PHILLIP'S IMPROVEMENTS IN THE CONSTRUCTION OF A SHIP'S COMPASS.

Fig. 5.

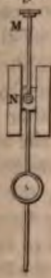


Fig. 1.

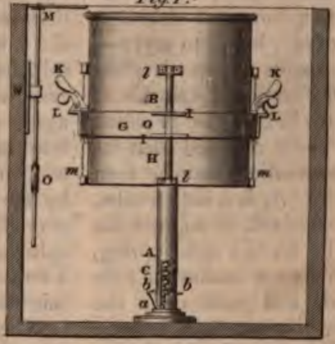


Fig. 3.

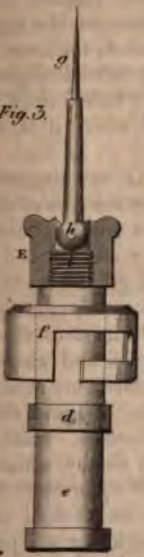


Fig. 2

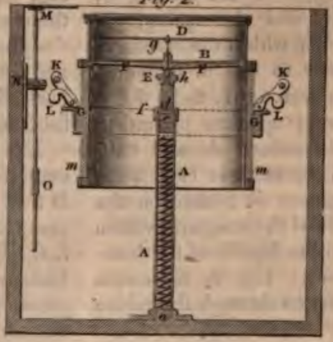
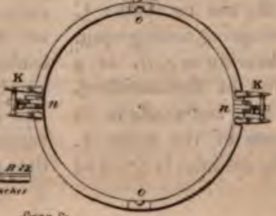


Fig. 4.



0 1 2 3 4 5 6 7 8 9 10 11 12
Inches

Swan Sc.

SPECIFICATION OF THE PATENT GRANTED TO CHARLES PHILLIPS,

OF UPNOR, IN THE PARISH OF FINDSBURY, IN THE COUNTY OF KENT, ESQ.

FOR A CERTAIN IMPROVEMENT OR IMPROVEMENTS IN THE CONSTRUCTION OF A SHIP'S COMPASS.

To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Charles Phillips, do hereby declare, that the nature of my said invention, and how the same may be performed, is herein set forth and explained, by the following description and drawings hereto annexed (that is to say) :—Fig. 1. represents a front elevation of one of my improved compasses, one side of the box or case in which it is fixed being removed that its peculiar construction may be seen more plainly. A, is a hollow tube, forming a standard, to support the compass : B, C, is a spiral spring, which is contained within the tube or standard, and rests upon the moveable bearing *a* : *b*, *b*, are two handles attached to the bearing *a*, by which it, and the spring, C, may be elevated within the standard, A, and made to rest in either of the recesses seen at 1, 2, 3, 4 : *c*, is a groove or aperture pierced in the tube or standard A, and connected with the recesses 1, 2, 3, 4. A similar groove is formed on the opposite side of the standard, within which the other handle of the bearing, *a*, moves. Fig. 2, represents a vertical section through the centre of fig. 1.

A, A, is the hollow tube or standard, and B, the compass: C shows the spiral spring resting upon the moveable bearing *a* : *d*, is a moveable portion of the standard. This is cylindrical, and made to fit the internal bore of the tube A. A portion of the cylinder is reduced at *e*, in order to prevent friction, it being necessary that the part *d*, should move up or down very freely within the tube A ; *f* is a cap, fixed upon the standard, A, by a bayonet joint; this cap prevents the spring, C, from forcing the cylinder, *d*, out of the tube A : *g*, is the pivot that carries the compass card D ; the lower end of the pivot has a spherical ball, as shown at *h*, which rests upon a surface of cornelian, agate, or any other hard stone, let into the top of the cylinder, as seen at *i*, and it is confined in that state by the cap E, the upper internal part of the cap being made hemispherical, so as to form a portion of a cup to cover the ball *h*, and permit it to move universally.

The lower internal part of the cap, E, screws on the upper end of the standard *d* ; the lower portion of the pivot *g*, is made slightly conical, and fits in a hole formed in the crop bars, F, F, where it is retained by friction.

Fig. 1, G, is a ring of lead, circumscribing the case of the compass B : H is a guide, attached to the compass by sockets and screws at *l*, *l*. This guide goes through the leaden ring, and also through the brass piece, I, I, let into the ring. A similar guide, and also the other parts described, are attached to the case on the opposite side. K, K, are two handles, fastened to the leaden ring G, by which means it can be lifted up or down at pleasure, and it may be retained at any convenient height by the palls, L, L, dropping into the notches of the racks, *m*, *m*, which racks are screwed to the sides of the case B.

Fig 3, represents an elevation of the upper and moveable part of the standard *d*, detached from the tube in which it moves, in order that the spherical ball, N, resting upon its agate, bearing, *i*, may be better seen.

Fig. 4, shews a plan of the ring G: the recesses, *n*, *n*, receive the racks, *m*, *m*, and the grooves or recesses, *o*, *o*, permit the guides, B, fig. 1, to pass freely through them.

M, fig. 2, represents a side view of the lubber's point, suspended and moving upon the centre N. The centre, N, is placed between two guides, and may be raised or lowered at pleasure, being retained by a spring fixed to the moving centre, N, which takes its bearing against one of the guides (a front view of this will be seen in fig. 6:) *o* is a pendulum bob, placed upon the stem of the lubber's point, which may be moved any where upon the stem, and it may be retained in any situation by a spring contained within the bob. This is to be adjusted so that the lubber's point, M, on the top, will be even with the upper edge of the compass, which may be done by raising or lowering the point of suspension, N, between the guides, until the desired adjustment is effected. The brass bob, *o*, should be shifted on the stem until its centre agrees with the centre of the leaden ring, by which means the lubber's point will correspond with those of the compass.

Having enumerated the various parts, and shewn how they are constructed and combined, I shall now endeavour to explain the peculiar advantages that result from the improvements I have invented.

In fig. 2, the upper part of the standard, *d*, is seen resting upon the top of the spiral spring, C: therefore, when the firing of cannon, or any other circumstances, produce violent concussions, such as the sudden jerks produce by the paddles of a steam-boat, &c. the spiral spring will yield, and permit the compass to descend gently, which will effectually prevent the card from being unshipped, or thrown off its pivot, by any jar, however violent. In fine weather the spiral spring, C, should be raised by the handles, *b*, *b*, fig. 1, until the compass receives the full effect of the spiral spring. This will prevent any injury from a sudden blow or concussion, and it will also keep the compass card always sensible.

Should the motion of the compass box or case be too great in a vertical direction, the spiral spring must be regulated to suit it by removing the handles, *b*, *b*, up or down, and placing them in either of the notches 1, 2, 3, 4, till the requisite motion is obtained.

To regulate the pendulous motion of the compass box to suit the changes of the weather, the leaden ring, G, must be raised or lowered by the handles, K, K, as circumstances may require. Whenever it blows hard the leaden ring must be raised to such a height as to reduce the motion to that degree which shall be most convenient; for instance, when the weather is bad the leaden ring, G, must be raised as high as the racks, *m*, *m*, on each side will permit; and in fine weather, on the contrary, as low as it will allow. Thus the pendulous motion of the compass may be adjusted to suit the circumstances of the weather in any case, and the palls, L, L, will drop into the teeth of the racks, and retain it there.

For I shall here observe, the intention of the leaden ring is to form an adjustable weight, by which the centre of gravity of the compass box may either be raised or lowered at pleasure. By this simple contrivance, the motion of the compass box upon its spherical bearing may be equalized in all weather.

But in order to identify and distinguish my invention more clearly, I hereby declare that it consists,

Firstly, in suspending or supporting a ship's compass upon bearings connected or combined with an elastic spring or springs, by the application of which, in the way I have described, the unpleasant effects that have hitherto been experienced from sudden blows or concussions will be completely avoided; and, consequently, the compass card will be more secure from being thrown off the pivot than by any of the methods hitherto known or made use of by the public.

Secondly, I claim also the application of a moveable ring or weight to a ship's compass, united to the other adjusting appendages explained in the drawing; which, being combined and applied in the way I have described, will enable any person to regulate the pendulous motion of a ship's compass, and thereby produce a greater degree of sensibility in that instrument than was ever before known or made use of.

And I shall here further observe, that although I prefer the method of supporting the moveable weight, G, by means of racks and palls, as shewn in the drawings, yet the same may be suspended from the case of the compass by three chains, the links of which may be placed upon hooks fixed in the case, or by a variety of means known to workmen, without departing from the principle contained in my invention, namely, that of suspending or supporting ship's compasses upon elastic springs, by which means the effects of concussions will be avoided. And also by applying a moveable weight to the cases of compasses, they may be rendered more sensible than by any means hitherto known or made use of.

And, thirdly, I claim the right of making the suspending, or centre of a lubber's point, moveable; and also of making the pendulous bob moveable; by which means an adjustment may be obtained that will, at all times, coincide with the motion of the compass.

In witness whereof, &c. &c.

PROPERTIES OF MATTER.

Elements, in physics, the first principles of which all bodies in the system of nature are composed. These are supposed to be few in number, unchangeable, and by their combinations, to produce that extensive variety of objects to be met with in the works of nature.

That there is in reality some foundation for this doctrine of elementary bodies is plain; for there are some principles evidently exempted from every change or decay, and which can be mixed or changed into different forms of matter. A person who surveys the works of nature in an inattentive manner, may perhaps form a contrary opinion, when he considers the numerous tribes of fossils, plants, and animals with the wonderful variety that appears among them in almost every instance. He may from thence be induced to conclude, that nature employs a vast variety of materials in producing such prodigious diversity. But let him inquire into the origin of this apparent diversity, and he will find that these bodies which seem the most different from each other are at bottom nearly the same. Thus the blood, chyle, milk, wine, &c. as well as the various solid parts of animals, are all composed of one particular substance: grass, for instance, by the assistance of air and water, and even sometimes of very insipid kinds of grass. The same simplicity presents itself in the original composition of the nourishment of vegetables, notwithstanding the variety among them with respect to hardness, softness, elasticity, taste, odour, and medical qualities. They chiefly depend, for these, upon water and the light of the sun; and the same simplicity must take place in animals that are fed on vegetables. The analysis of animal substances confirm this hypothesis; for they can all be reduced into a few principles, which are the same in all, and only differ with regard to the properties in which they are combined. With regard to animals, the case appears to be the same: and the more we are acquainted with them, the more reason we have to believe that the variety in their origin is very small.

Notwithstanding the infinite variety of natural productions, it appears, that the materials employed in their production are but few; that these are uniformly and certainly the same, totally exempted from any change or decay; and that the constant and gradual change of one body into another is produced by the various separations and combinations of the original and elementary parts, which is plain from the regularity and uniformity of nature at all times. There is a change of forms and combinations through which it passes, and this has been the case from the earliest accounts of time; the productions of nature have always been of the same kind, and succeeded one another in the same order. If we examine an oak, for instance, we find it composed of the same matter with that of any other that has existed from the earliest ages. This regularity and uniformity in the course of nature shews that the elementary parts of bodies are permanent and unchangeable; for if these elementary particles which constituted an oak some thousand years ago, had been undergoing any gradual decay, the oaks of the present times would have been found considerably different from those that existed long ago; but as no difference has been observed, it would seem that the ultimate elements of bodies have always continued the same.

Reflections of this kind have suggested an idea of several principal elements of which all other bodies are composed, which by their various combinations furnished all the variety of natural bodies. Democritus and other great philosophers of antiquity, fixed the number to four which have retained the name of elements ever since. These are, fire, air, earth, and water; each of which they imagined was naturally disposed to hold its own place in the universe. Thus, the earth, as heaviest, naturally tended toward the centre, and occupied the lower parts; the water, as approaching next to it in gravity, was spread chiefly on the outside of the earth, the air, being more subtile and rare, occupied the middle place; while the fire, being more subtile and active, receded to the greatest distance of all, and was supposed to compose the planets and star. This system was extended to all the productions of nature. Meteors were produced from a combination of fire and air; animals were considered as composed of earth and water; and those that were warm had likewise a proportion of element of fire. Thus they went on, explaining some of the most striking qualities of the several productions of nature from the difficult proportions of the four elements they contained.

But though this system appears not all destitute of beauty and propriety, and on this account has been, in some measure, received even to the present time, we find reason to doubt whether these four substances be really elementary bodies; nor do they answer our purpose in forming a system, as we know too little of the intimate structure and texture of them to enable us to explain other bodies by them.

Any other attempts that have been made to assign the number of elementary bodies have been much less fortunate. The chemists with Paracellus at their head, pretend to speak of four elementary bodies, salt, sulphur, earth, and mercury; but when we attempt to form an idea of what they mean, we find it very perplexed; and that the expressions concerning them are enveloped in so much obscurity, that they cannot be comprehended; and the theory is built entirely upon experiments made on metallic substances.

By experiments in *chemistry*, it may be shown, that the elements, whatever they are, must necessarily be invisible or imperceptible by any of our senses. An inquiry into their number or properties must be attended with very little success: and all the knowledge we can have upon the subject must be drawn from a view of their combinations, and reasoning analogically *from the transmutations* we observe *to take place in* nature. The *modern discoveries in* aerology have enabled us to proceed farther in this way than what it was possible for the ancient philosophers to do. We now find that all the different kinds of air are composed of that invisible and subtile fluid named *heat*, united in a certain way with some other subtance: by which union the compound acquires the properties of gravitation, expansion, rarefaction, &c. for pure heat, unless when united with some terrestrial substance, neither gravitates nor expands. This is evident from the phenomena of the burning-glass where the light concentrated in the focus will neither heat the air nor water, unless it meets with something with which it can form a permanent union. Heat, therefore, is justly to be considered as one of the original elements; being always capable of uniting with bodies, and of being extricated from them unchanged, while the same bodies are by their union with it changed into various forms; water, for instance, into ice or vapour, both of which return into their original state by the abstraction or addition of heat in a certain degree. Hence it becomes almost natural to conclude, that there are only two elements in the universe; and this opinion we find adopted by several philosophers, particularly the Count de Tressan in his Essay on the Electric Fluid. According to this doctrine, two primitive material substances seem to exist in nature; one that incessantly acts, and to which it is essential to be in motion, the other absolutely passive, and whose nature it is to be inert, and move entirely as directed by the former. Should this doctrine be adopted, little difficulty would occur in determining the active matter to be that universal fluid which, in its various modification of light, heat, and electricity, has such a share in the operations of nature. But in fixing on the passive element we are greatly embarrassed; nor are the discoveries in aerology or any other science as yet able to remove difficulty entirely. In our experiments on this and some other parts of chemistry, we find three things that seem to be unchangeable, viz. earth, carbon, and that invisible, though terrestrial and gravitating principle, called the oxygenous or acidyfying principle, the basis of oxigen gas.

THE WRITINGS OF PROFESSOR ANDERSON, &c.

Gentlemen,—Your biographical correspondent of Professor Anderson has exposed to the public what was not generally known to exist, to wit, a catalogue of not less than twenty-three important unpublished manuscripts of the late Professor, and I have little doubt if published, they will tend to establish the great ability, learning, erudition, and ingenuity of the benevolent Founder of Popular Lectures. It is astonishing that, after the lapse of thirty years from the time of his death, not one of the ordinary Managers or Professors have urged the propriety of immediately printing and publishing the manuscripts he left behind him, and this too in the very face of one of his eighteenth last requests in the codicil to his will, viz.

"*Eighth.* To receive annually my share of the Tontine, and not to sell it, but to apply it as a fund of the Institution, if Miss Colquhoun should happen to be the longest liver. To apply the profits of my books which are to be printed on Physical subjects, and upon Artillery, to the benefit of the Institution in the same manner."

"*Ninth.* Mr. Meikleham, and John Parsell, under the direction of the ordinary Managers, will be pleased to see that all my manuscripts, letters, and papers shall be deposited carefully in the two glass presses in my white-room, with a green cloth in the inside of the glass, that they shall never be lent out to any person, nor even shewn except by the express order of Mr. Meikleham, his successor in office, and the ordinary managers."

Mr. Meikleham was soon after the death of Professor Anderson appointed Rector of the Academy at Ayr, and the depositing of the letters, papers, and manuscripts, in the two glass presses above mentioned, was most religiously and precisely performed by John Parsell.

It must be evident from the eighth and ninth last requests above quoted, that the Professor was somewhat afraid of his fair fame, in being robbed of the merit of his manuscripts by plagiarists, and hence his caution to Mr. Meikleham and the ordinary Managers, to be careful of what kind of persons they shewed these MSS. to, and hence too an additional reason for their being printed and published without delay.—I am, Sir,

Your most obedt. Servt.

A. B.

Glasgow, 18th May, 1826.

GLASGOW MECHANICS' INSTITUTION.

CONVERSATION CLASS.

In our last, we promised to publish this week a copy of the Report of the Conversation Class, which was read by one of their number at the Meeting of the Institution on 12th May; and for which, with other particulars regarding that very useful Class, we are indebted to one of the members. The Report was nearly as follows:—

Mr. President and Gentlemen of the Committee, I am commissioned to give you the Report of the Conversation Class. We feel ourselves indebted to you in the greatest degree possible, for the kind manner with which you have been pleased to distinguish us; and we return you our warmest and most heartfelt acknowledgments, as also we do to Mr. Deuchar, who, with the most unremitting care, hath forwarded our knowledge in the Sciences, which we have had the pleasure to study under his management and direction.

We have agreed that the First Prize of Merit be presented to Mr. Fairservice; the Second to Mr. Syme; and the Third to Mr. M'Leod. And as the merit of the persons to whom they are given has been the only motive that swayed our minds, we hope it will be a spur to ourselves, as well as to the members of the Institution in general, (should this mode of instruction ever be resumed at a future period,) not only to enter, but strive to distinguish themselves in a Class so highly favoured, and from which so much benefit has been derived.

We remain, gentlemen, with all feelings of due respect, yours, &c.

Then follow the signatures.

Although the evening was far gone before the Lecture and distribution of Premiums were completed, yet the Conversation Class remained after the dismission of the Institution, for the purpose of thanking Mr. Deuchar for his attention to them during the Winter Conversations; when Mr. Neil M'Lardie spoke in nearly the following terms:—

"We have collected ourselves again in our places, even at this late hour, because the ardour of our gratitude would not allow us to part silently; and I have been appointed by the Class to express to you, Mr. Deuchar, our respected instructor, that we entertain sentiments of great regard for your character and abilities, and above all, our thanks are due for the great advancement in scientific knowledge, which we are all so sensible we have made under your direction. You have brought forward the truths of science in so simple and alluring a form, that we have never found instruction tedious; and the facts explained in the course of the Lectures have had a double effect upon our minds, by means of the happy manner in which they have been recalled, and further explained in the Conversation Class. We hope we will long enjoy the advantages we have had this winter, and that we shall continue to profit by your instructions. The feelings we entertain with regard to you, for your unremitting attention to us during the whole of the examinations,—the modest manner in which you pointed out any errors into which we had fallen,—and the readiness with which you, at all times, listened to, and removed our difficulties,—as also for the hints and advice you have suggested for the prosecution of our studies, and the warm interest you have always taken in our welfare ;—our feeling on these accounts we cannot express in language, however sincere they are; but they have made a lasting impression which time cannot erase.

"Some of us, who have been members of the Glasgow Mechanics' Institution from its commencement, think it proper to acknowledge to you, that the benefit we thereby acquired was trifling, in comparison with what it has been since we attended your Conversation Class, for it was, in fact, here that we first imbibed scientific knowledge, and knew its value.

"We have also to mention, that we have formed ourselves into a society, for the purpose of forwarding our knowledge in the arts and sciences by writing Essays, by performing Experiments, and by conversing together on these subjects, upon a plan similar to that which you have taught us in this Class, and which has been in every respect so beneficial.

"We thank you for your kind indulgence and attention to us, and wish you every success in your various duties."

Our limits do not admit of our giving a full Report of Mr. Deuchar's reply. He expressed to them the pleasure he felt by the information that he had fulfilled his duty in a way that met their approbation, at the same time that it had forwarded their scientific studies; that it had all along been highly gratifying to him to perceive the enthusiasm and zeal which had actuated the whole of the Class during their arduous study and attendance; and that notwithstanding the late hour to which their conversations had often been protracted, yet still they seemed always to leave the Hall with regret; that such *persevering assiduity*, if *shewn in an equal degree* to every duty in life could not fail to secure that success which would make them bright ornaments in whatever department of society they might be called to fill. It was pleasing to him to hear of the society which they had formed, and he trusted they would find it to be productive of great advantage. The privileges which they enjoyed in this enlightened country were great, in so far as regarded the instruction they could so easily procure from Mechanic Institutions, and from Scientific Libraries; but these, if taken by themselves, were not the most beneficial modes of instruction,—far before them must be placed the advantages of practical investigations, and of conversations upon what has been previously read or heard; these latter modes arouse the attention, impress the facts, and more clearly satisfy the judgment. The Mechanic, somewhat exhausted by the labours of the day, is apt to think the demonstrations of even a celebrated work, and the simple illustrations of a lecture too tedious; but his attention is kept alive when he is called upon himself to answer and demonstrate, and when he is required to perform the illustrations with the apparatus in his own hand. He advised them to proceed regularly in their investigations, till they had gone over the whole elementary range of Science; at first they must expect to meet with difficulties; these, however, would gradually yield to perseverance; and determined steadiness would secure ultimate success. He concluded by assuring them, of the pleasure he would feel could he, at any time, assist them in forwarding the laudable and useful undertaking upon which they were about to enter, as he could not fail to take a lively interest in their sucss.—*Extracted from the Minutes.*

Neil M'Lardy, Treasurer.

ON THE NATURE AND CALCULATION OF LOGARITHMS.

THE indexes of powers serve many valuable purposes both in Algebra and Geometry, but more particularly in Trigonometrical calculations, the labour of which are often greatly diminished by a property peculiar to these powers, and sometimes solutions are effected by their means, which without them would be impossible. This sort of computation I shall now endeavour to explain in my remarks on the following small table.

A	B	A	B
100000	$= 10^5$	$\frac{1}{10}$	$= 10^1$
10000	$= 10^4$	$\frac{1}{100}$	$= 10^4$
1000	$= 10^3$	$\frac{1}{1000}$	$= 10^3$
100	$= 10^2$	$\frac{1}{10000}$	$= 10^4$
1	$= 10^0$	$\frac{1}{100000}$	$= 10^5$

The column A contains the different powers of 10 indicated in the column B. The little figures which we call exponants when considered in relation to the powers of which they are the indices, are called logarithms when considered in relation to the powers themselves. Thus 2 is the exponant of 10^2, but it is the logarithm of 100, the power indicated by 10^2; 4 is the exponant of 10^4 in the logarithm of 10000: that is to say, every exponant of any quantity is the logarithm of the power indicated by that exponant.

The exponants of the increasing progression, are repeated in the decreasing progression with this difference, that they are all plus in the first, minus in the second: 10^1, 10^2, 10^3, &c., 10^1, 10^2, 10^3, &c. Thus the same figures, according as they are plus or minus, are the logarithms of powers greater or less than unity, and therefore if we have the logarithms of all intermediate numbers of *an increasing* progression, we shall *have also the* logarithms of all the *numbers of a* decreasing progression, by merely changing their signs, thus the logarithm of $\frac{1}{10}$ is — 1, that of 10 is + 1.

If we add 2, to the logarithm of 100 to 3, the logarithm of 1000, we shall have for the sum 5, the logarithm of 100.000, and thus without having occasion to make any multiplication, we find in the table, opposite to 5, the product of 100 by 1000: if, on the contrary, we subtract 3, the logarithms of 1000 from 5, the logarithms of 100000, there remains 2, the logarithms of 100, and a simple subtraction shews us opposite to 2, the quotient of 100.000 divided by 1000.

Thus we see then that a table of logarithms which comprehends all the numbers from 1 to 100000, will afford us no small compendium in multiplication, and division. It would also be of even more advantage in the finding of powers and roots, by a proceeding so simple as to render the long methods usually employed almost useless. Thus if we multiply by 2, the logarithm of any number, we have that of its square: by dividing the same logarithm by 2, we shall have that of its square root: and the same thing happens with regard to other powers and other roots, it is sufficient to take their exponants for multipliers or divisers of the given logarithms.

The calculation of these tables is a work of great labour, and hence many methods have been devised to render the process easy; these may be found in books treating particularly on logarithms, but it is sufficient for the present purpose to understand one mode of forming a series of numbers, which shall be the logarithm of another series.

The increasing progression with which we commenced, gives 0 for the logarithm of unity, and 1 for that of 10. It is evident, that we can insert between 0 and 1 any number of arithmetical means we choose. It is also plain, that between 1 and 10, the two first terms of the increasing progression, we can equally well insert any number whatever of Geometric means, it is sufficient for that, to raise 10 to fractional powers.

In fact, it is evident that the progression of Arithmetical means, may correspond term for term, to the progression of Geometrical means, and that consequently every term in the first will be the exponant, or the logarithm of the power which shall correspond to it in the second.

Or if we divide the interval from 0 to 1 into 10 million parts, or which is the same thing, if we insert in this interval, 9999999 Arithmetical means, these two terms 0 and 1 become the extremes of a progression, which shall have for its common difference $\frac{1}{1000000}$, and the terms of this Arithmetical progression will be the logarithms of an equal number of terms which are in Geometrical progression, from 1 to 10.

In so great a number of Geometric means, inserted between 1 and 10, there will be without doubt some, for which, without fear of error, we may substitute the numbers, 1, 2, 3, 4, 5, 6, 7, 8, 9, and consequently the logarithms of these means become the logarithms of these members themselves.

We shall then have a table formed, from an Arithmetical progressive from 0 to 1, and a corresponding Geometrical progressive from 1 to 10.

We may find a Geometric mean between 1 and 10 by the proportion $1 : n : n : 10$, which gives $n^2 = 10$, and $n = \sqrt{10}$, and we *know that the root of 10 will approach nearer to the value sought,* as it is expressed by a greater number of decimal parts; it will become for example, $n = 3.1622776$ if we carry the extraction to the seventh decimal figure.

The logarithm of this number is the mean which corresponds to it in the Arithmetical series from 0 to 1.

But because the Geometrical mean contains 7 decimal places, the corresponding Arithmetical mean ought to carry an equal number, and therefore we should represent the two terms of the series 0 and 1, by 0.0000000 and 1.0000000 then the proportion $0.0000000 : n : : n$ 1.0000000 gives $2\,n = 1.0000000$, and $n = \frac{1.0000000}{2} = 0.5000000$, and this of 3.1622776.

The number 3.1622776, is too great to be substituted for 3, but it is too small to be substituted for 4, the decimal fraction 0.5000000 is therefore the logarithm of neither the one nor the other. But between 1 and 3.1622776 we may find a mean which approaches 3 as near as $\frac{1}{10000000}$ and which will have its logarithm between 1 and 5.0000000. So also the other numbers 4, 5, 6, 7, 8, 9, ought to be found between 3.1622776 and 10, and their logarithms between 0.5000000 and 1.

Because 3 is between 1 and 3.1622776. I make the two correspondent proportions, the one Arithmetical the other Geometrical.

$$0.0000000 : n : n : 0.5000000$$
$$1 : n : n : 3.1622776,$$

The second gives $n = \sqrt{3.1622776}$. $= 1.7782794$, and the first $2\,n = 0.5000000$, therefore $n = 0.2500000$.

We had before found a Geometric mean too great, we have now found it too little ; it is therefore between 3.1622776, and 1.77827-

94, a nearer approximation must be sought; and it is between 0.5000000, and 0.2500000 that its corresponding Arithmetical mean will be found. I therefore make the following proportions.

3.1622776 : n : n : 1.7782794.
0.5000000 : n : n : 0.2500000.

I find for the third Geometrical mean, therefore, 2.3713717.

But this number being still too small, I must repeat the same reasoning, and the same operation. I consider 2.3713737, and 3.1622776 as the extremes of a Geometrical progression, and their logarithms as the extremes of a corresponding Arithmetical progression, consequently,

2.3713737 : n : n : 3.1622776.
0.2500000 : n : n : 0.3750000.

Continuing to take a Geometric mean between the two, of which the one is greater and the other less than three, we shall arrive after the twenty-sixth operation, at a number, which would only differ by a unit in the seventh place of decimals: that is, this number would differ from 3 by only the $\frac{1}{10000000}$ part of unity. We may therefore take for the logarithm of three, the logarithm of this number.

To determine the logarithm of 5, we may seek a Geometric mean between 3.1622776 and 10, and an Arithmetical mean between 0.5000000 and 1.0000000. We shall find for the first, $n = \sqrt{10 \times 3.1622776} = \sqrt{31.622776} = 5.6234132$, and for the second, $n = \frac{1.5000000}{2} = 0.7500000$.

But because that Geometrical mean is too great to be substituted for 5, it is necessary to seek another, *between 3,1622776*, and 5.6234132, which process must be repeated like the former, 26 times.

5.6234132 a Geometrical mean, too great for 5, would be too small for 7: it is therefore between 5.6234132, and 10, and this logarithm will be found in the same manner as before, after the twenty-sixth operation.

When we have the logarithms of 3, of 5, and of 7, all the others from 1 to 10, may be found without much difficulty. We shall find the logarithm of two by subtracting that of 5 from that of 10; for $2 = \frac{10}{5}$ and therefore log. 2, = log. 10, — log. 5. By doubling the logarithm of 2, we shall have that of 4 its square. Tripling that of 8, its cube, we may add the logarithm of 2, to that of 3, for that of 6, the product of 3 by 2; and to have that of 9, we may multiply log. 3 by 2, for 9 is the square of 3.

These logarithms being determined, we may find an infinity of others. Those of products by adding, the logarithms of factor, those of quotients by subtracting the logarithms of the divisor, from these of the dividends: the logarithms of powers, squares, cubes, &c, by multiplying by the exponants 2, 3, &c. whether whole or fractional. There are, however, certain numbers called prime numbers, each as 11, 13, 17, 19, &c. whose logarithms cannot be found in this way, but must be determined in the same manner with those of 3, 5, 7.

The table which we have now been considering, has for its base the number 10. All the numbers which it contains, have been obtained by raising 10 successively to different powers, and so we have filled the interval from 1 to 10, by a series of fractional powers of 10, we must insert between 10 and 100, a series of fractional powers of 10 times 10, 1000 another series of 10 times 100, and so on. All numbers of this table, whatever extent be given to it, are but the different powers of its base.

From 1 to 10 exclusively, the logarithms are proper fractions, or they are less than unity: the logarithms of 10, 100, 1000, &c. are whole numbers, without any fractions appended, but all the intermediate numbers are composed of a whole number, and a decimal fraction, which two parts together form the exponant of a power of 10, equal to the number written opposite. Thus 1.0791812 the logarithm of 12 is the exponant of that power of 10, which is equal to 12.

The first part of the logarithm, that is to say, that where it is found a whole number, or zero if it be a proper fraction, is called the *characteristic* of the logarithm. From 1 to 10, this characteristic is 0 from 10 to 100, it is, from 100 to 1000, it is 2, &c., being the different powers of 10 multiplied by itself, 10^0, 10^1, 10^2, 10^3. &c. But all these exponants are comprised under the general demonstration of characteristics, because by them we judge the true value of the number in the same manner, as by seeing a number, we know what ought to be the characteristic of its logarithm.

But it is plain, no table can comprehend all numbers. Besides there are those composed of whole numbers and fractions, as well as those which are purely fractional; how are they to be supplied?

If we suppose the table of which we make use, to contain numbers only to 20000, and that we wish to have that of 788873; we must observe that this number may be written 7888.73. This however makes it 100 times less, but when we have found the logarithm of 7888.73, we shall make it one hundred times greater, by adding two units to the characteristic.

In the second place, we may remark that the difference of the two numbers 7888, and 7889 is unity, but the difference of their logarithms is 0.0000551, and that of 7888.73, and 7888 is 0.73. Then supposing that the differences of two numbers which differ but little from each other, are to each other as the differences of their logarithms, we may make the proportion.

1 : 0.0000551 :: 0.73 : *n*.

And we shall find in the value of *n* the difference of the logarithm 7888 from that 7888.73.

The proportion gives $n = 0.000040223$, which we may reduce to $n = 0.0000402$ because we need only seven decimal figures.

Now we see in the tables, that the logarithm of 7888 is 3.8969669, add to this logarithm the difference of that of 7888, from that of 7888.73; that is to say, 0.0000402, and we shall have 3.8970071 for the logarithm of 7888.73. It is now only necessary to add two units to the characteristics, and the logarithms of 7888.73 will be 5.8970071.

If I seek in the tables 3.999777, I do not find this logarithm; but I see that it ought to be between that of 7942, and that of 7943. It is evidently therefore the logarithm of a number composed of two parts, of which the one is the whole number 7942, and the other a decimal fraction. To find this fraction, I say, the difference of the logarithm of two numbers 7942, and 7943 is to the difference of the logarithm of 7942, and 3.8999777 as unity, is to a fourth proportional, that is,

0.0000547 : 0.0000478 :: 1 ; *n*

i. e. 547 : : : 1 : *n*

we must insert between 100 and

$\therefore n = \frac{478}{547}$ a fraction, which reduced to decimal parts is nearly equal to 0.874. The numbers sought is then 7942.874.

Suppose we would find the logarithm of the fraction $\frac{3}{8}$. It is the reciprocal of $\frac{8}{3}$, of which log. 8—log. 3 found in the tables = 0.4259687, and making the Geometrical proportion $\frac{8}{3} : 1 :: 1 ; \frac{3}{8}$, and to this proportion a corresponding Arithmetical one, of which the sum of the extremes is 0 because that of the means is likewise, and the sum of the extremes cannot be 0, unless each of the logarithms are the same, but minus for the one, and plus for the other. That of $\frac{3}{8}$ is therefore — 0.425687.

We have chosen for the base of the tables of logarithms, the number 10, because it renders it more analogous to numeration, and consequently is more commodious in its applications. But it may be useful to take a general view of all tables which can be constructed on any base whatever. This manner of considering acquired knowledge, helps us to new things, because it places in the same point of view what we do know, with what we do not. To generalize, it is true, is a dangerous rock in common language, but it is the great artifice of algebra, and analysis.

For 10 let us substitute a, and let it represent generally all the numbers taken for bases to any system of logarithms.

Whatever variety there may be in the tables constructed upon this general base, the numbers which they contain will always be a, raised to differ successive powers.

Therefore all the powers of a may be expressed generally by m; then a^m is a general expression, which embraces all possible numbers of all possible tables.

In all these tables 0 is the log. of unity, for $a^0 = 1$, and 1 is the log. of the base a, for $a = a^1$.

But the powers greater than unity, are a^1, a^2, a^3, &c., and the powers less than unity, a^1 a^2 a^3, &c. The logarithms are the same, for such powers as we can consider as the extremes of a, proportion of which unity is the mean term, the only difference is, that they will be plus for the powers above unity, and minus less than unity. Shall we have all the logarithms of intermediate means, from a^0, to a^1, a^2, &c. When we have those of the intermediate means from a^0, to a^1, a^2, a^3, &c. By adding the exponants we find the product of powers. But the exponants of powers indicated, are the logarithms of the powers themselves; we shall have, therefore, the logarithm of the product of any numbers, if we take the sum of their logarithms. Log. a^3 = log. a + log. a = 3. log a: in general, log. $a^m = m$, log. a.

As multiplication is reduced to an addition, so also division is reduced to a subtraction, thus log. $\frac{-a}{b}$ or log $a\ b^1$ = log. a — log. 6.

In fact, to raise a number to a power, whether whole or fractions, it is only necessary to multiply the logarithm of this number by the exponant of the proposed power. 2 log. a = log. a^2, $\frac{1}{2}$ log. $a = a^{\frac{1}{2}}$.

This is a recapitulation of the general properties of logarithms. Having become familiar before hand with these general views, we may consider two tables, the one constructed upon the base a, and the other upon the base b, and let n be the general exponant of the powers of b, as m is that of the powers of a. In the first, the logarithms would be found from the proportion $1 : n : n : a$. In the second, from the proportion $1 : n : n : b$; and because a and b are two different numbers, it is plain the logarithms cannot be the same in the two tables. Any number whatever, will have consequently in the one n for its logarithm. Then $p = a^m$, and $p = b^n$, from whence $a^m = b^n$, $b_n^n = a^{\frac{m}{n}} = a^{\frac{m}{n}} \therefore b = a^{\frac{m}{n}}$; and consequently the logarithm of a number being known upon the base a, we may find its logarithm on the base b, it is only to determine the two terms of the fraction $\frac{m}{n}$ which of course depend upon the base a and b.

Let there be for example. $a = 10$, and $b = 7$, we shall have for the logarithm of 7 upon the base $7 = 7$, $n = 1$: and upon the base $a = 10$ we shall find in the tables, logarithm 7. or $m = 0.845098$. Therefore, $\frac{m}{n} = \frac{0.845098}{1}$; and we may draw from this equation a general expression of the value of n, compared to m. For $n = m \div \frac{845098}{1000000} = m \times \frac{1000000}{848098} = m \times 1.18329$.

Now if you wish to know the logarithm of any number whatever, upon the base 7, seek it in the tables which have 10 for their base, substitute it for min. the last equation $n = m \times 1.18329$, and by performing the multiplication, we find the corresponding logarithm on the base 7.

B. Taurus.

LETTERS AND QUERIES.

GENTLEMEN,—I observe in your Magazine for last week, a list of the Writings of the Founder of Mechanics' Institutions, and, I believe, from the connexion the writer had with Professor Anderson, that the list is correct. I think the Trustees should give them to the world, as from what I have seen of the Professor's writings, I believe they would be exceedingly interesting.

I observe from his "Institutes of Physics," that he had invented a clepsydra or water clock, which measures time with great accuracy, and, as I believe, the model is still in his Institution, I should feel obliged if any of your correspondents would favour us with a drawing and description.

His "Institutes of Physics" is a book, which ought to be in the hands of every person attending a Mechanics' Institution. The name does not at all convey to ordinary readers the nature of its contents. It ought more properly to be entitled "The First Principles of natural Philosophy;" and although printed in 1795 and though containing some things which modern science has discovered to be incorrect, it is, upon the whole, a book of very great importance, and ought to be more extensively known and studied by the students attending the Lectures in our Scientific Institutions.

J. G.

23d May, 1826.

GENTLEMEN,—At the present disastrous crisis, when so many of our fellow townsmen are unable to obtain work at their usual employments, and when the richer classes have stepped so humanely forward to their relief, it is of great consequence to employ them at some labour, so as to preserve that independent spirit which prevents a Scotchman from accepting *charity*, even in extreme privation. The breaking of metal employs a certain number, but the strength necessary for making any great progress at the occupation is seldom to be met with among weavers who form the greater number of those at present out of employment. The public were led to expect that the improvement of the Harbour would have enabled the Magistrates to give employment to many of the operatives; but as these improvements are at present unhappily prevented by a want of agreement between the parties interested, it is become of some importance to inquire in what manner the fund which has been raised for their relief ought to be applied; and I, therefore, beg leave, through the medium of your useful Magazine, to recall to the minds of the committee a plan which was long ago proposed by our indefatigable superintendent Mr. Cleland.

It must be obvious to every person acquainted with the resources of the city, that the citizens have no safe and agreeable place for bathing; the common resort is the "Dominie's Hole," but the number of accidents yearly occurring there point it out as a very unsafe place; its depth is so various and uncertain, that, except good swimmers who have made many *soundings*, few people care to risk themselves into an uncertain stream, and very many are thus prevented from availing themselves of the pleasure of a cooling Bath, so

"Halesome now in *May*."

Mr. Cleland proposed some years ago, the erection or sinking of large baths in the Flesher's Haugh, and by allowing the water from the river free ingress and egress, to afford the citizens an opportunity of promoting their health without any risk of accident. The present time seems peculiarly adapted for putting the plan into execution. A fund has been subscribed, which must be expended; and if it can be expended in such a manner as to secure its legitimate object, and promote the improvement of the city and the health and safety of the citizens at the same time, surely such an opportunity ought not to be lost. I trust, therefore, that those who have the management of the fund will take this into their consideration; and if you could lay Mr. Cleland's mode of forming these baths again before the public it might have the effect of showing more forcibly its advantages.

G. G.

22d May, 1826.

GENTLEMEN,—Could you, or any of your intelligent correspondents, inform me of the best method of destroying the common black beetle or clock with which our houses are so much infested? I also would like to know if there be any possibility of preventing moths from visiting our wardrobes. And the best method of taking spots out of Nankeen, without discharging the colour or injuring the cloth?

Yours, obediently,

ELIZA.

Hutcheson Street.

GENTLEMEN,—I am desirous of procuring the best method of obtaining the gold from wastings, which are produced from old frames or other gilt work, in the profession which I follow, and would take it kind would you favour me with an early answer. The mode at present in use is to wash the old gold off with a piece of wet cloth; it is then placed in a pan, and as soon as settled, the water is poured off, leaving the dischargings behind which are dried and cooled. An immense deal of money has, however, been to no purpose expended from not knowing how to extract the gold from it.—I am, Gentlemen,

Yours, respectfully,

A CARVER AND GILDER.

Argyle Street, Glasgow.

GENTLEMEN,—In Vol. I. of your valuable Magazine, notice is taken of a Reflecting Telescope, constructed by a Mr. Dick of Perth, termed the Aerial Reflector. It is also stated, that a more detailed account of it would likely appear in some of the scientific journals. However, as I have as yet heard no more of it, I consider it a desideratum in such a scientific work as the Glasgow Mechanics' Magazine, and would, therefore, hope to see a minute description of it, accompanied with a drawing, very soon, which I am confident will be perused by many of your readers with great pleasure, and likewise oblige (although an humble mechanic,)

Your constant reader,

M.

Johnstone, 15th May, 1826.

[We shall endeavour in an early number to comply with the request of our correspondent, and have to thank him for calling our attention to the subject.]

An Inquirer requests to be favoured by some correspondent with information respecting the new Law, regarding Patents, framed in the present Session of Parliament.

TO CORRESPONDENTS.

We will feel obliged by 'Mr. John Grant Smith waiting on us at our publishers.'—' L. M'L. Coll,'—' J. A. Gallashiels'—' Curiosus,' &c. are received.

Published every Saturday, by W. R. M'PHUN, 86, Trongate, Glasgow, to whom Communications (post paid) must be addressed.

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THE GLASGOW
MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

"A wise man will hear, and will increase learning; and a man of understanding shall attain unto wise counsels."—*Solomon.*

No. CXXVIII. *Saturday, 3d June,* 1826. Price 3*d.*

LIFE PRESERVER, INVENTED BY CHARLES MACINTOSH, Esq. OF CROSSBASKET; NEW DANDY LOOMS; STIRLING'S IMPROVED STEAM ENGINE, &c.

Fig. 1.

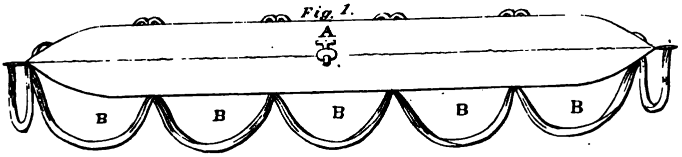


Fig 4.

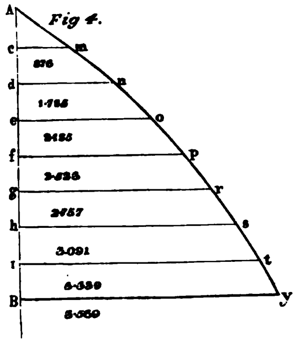


Fig. 3.

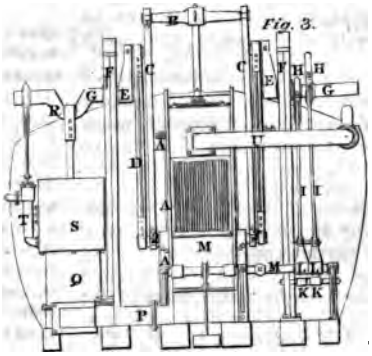
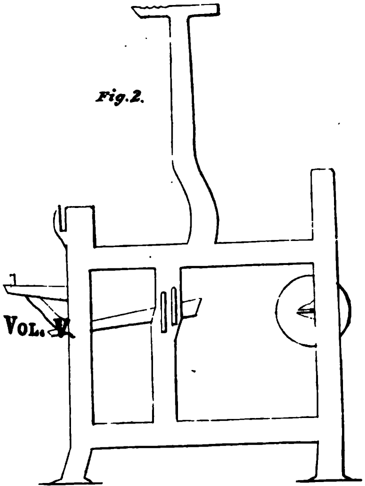
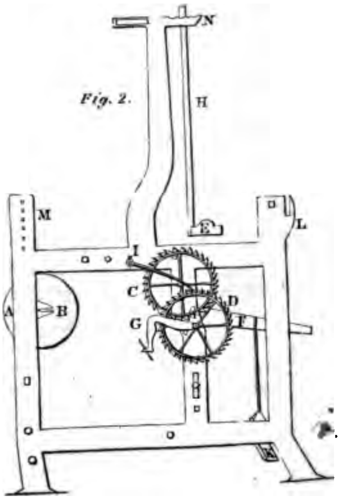


Fig.2.



Vol. V.

Fig. 2.



Swan sc.

LIFE PRESERVER.

The simplicity of this Machine is no less remarkable than its usefulness is unlimited. It consists simply of a ply of linen and cotton cloth rendered impervious by being interlaid with Mr. Macintosh's preparation of cahauchtee. There is at A, Fig. 1, a small brass cock through which the air is blown to fill the Machine, Along the top and bottom. B, B, B, B, are cords slung loosely, by which a person in danger of drowning may the more readily catch hold. This Machine is also used as a jacket. There is then but three cords made use of, one of which is slung across the shoulders, and another at each end to fix it round the body. The jacket is however exactly the same in every other respect.

It is impossible to state the full extent of the usefulness of this Machine. It can be used on so many different occasions, in such a variety of ways, and for the most important of all purposes,—the saving of human life,—at such a trifling expense, and with so little inconvenience to the parties engaged.

We would particularly call the attention of Steam Boat proprietors to this machine. Every vessel ought to have several of these life preservers constantly kept full of air and hanging within reach of the steers-man. He is always on the look out, and most frequently the first to see any accident which may occur. One of these thrown out to a person in danger of drowning would most assuredly be the means of saving him. The life preserver only weighs 12 or 13 ounces when filled with air, and is capable of bearing up 40 pounds weight. All such institutions as our Humane Societies ought, we think, to have a plentiful supply of these immediately at hand.

The swimming jackets are very useful to any person learning to swim, and also to those who can swim, in cases where they are seized with cramp. With this slung round their shoulders, and by blowing it full of air they would buoy themselves up above water until assistance arrived.

DANDY OR HAND LOOMS.

Gentlemen,—I herewith send you two rough sketches of Dandy or Hand Looms such as we have used in our works, in the town of Manchester, for a great many years past; although they may not be so neatly done as I could have wished, still I flatter myself that they will be sufficient to give your readers in general a pretty accurate idea of the loom. We consider the make of these looms to be rather a secret, but as I have authority from the proprietors to take drawings, and also to make what use I choose of them, I consider myself bound to send you a copy for your useful Magazine. I have only sent you the two sides, because the front and back are so similar to the old looms formerly in use, that any one acquainted with the subject may for himself supply this difficulty.—I remain, Gentlemen,

Yours, most respectfully,
John Grant Smith.

FIG. 2.

A, } Yarn Beam with flange.
B, }
C, Cloth Roller wheel.

D, Rack wheel.
E, End of Lathe.
F, Cloth Beam lever.
G, Rack lifter.
H, Lathe sword.
I, Rack catch.
K, Weight.
L, Breast Board.
M, Roller for yarn to pass over from yarn beam.
N, Lathe swing tree steps.

IMPROVEMENTS ON THE STEAM-ENGINE.—By John Stirling.

Gentlemen,—I observe in No. CXXIII. of your valuable Magazine, that a patent is taken out by Mr. Egell, for an improved Steam Engine.

Permit me to inform you, that about four years ago an idea suggested itself to me, that it might be possible to improve the construction of the Steam Engines usually made for propelling vessels, by making them without the side levers, and connecting the paddle wheel with the piston rod of the steam cylinder, by means of a crank or cranks above the cylinder, and obtaining a long connecting rod; I, therefore, beg leave to hand you for insertion in your valuable Work, (if you think it will be of any use,) the drawing I made out at that time It will be observed, by comparing it with Mr. Egell's, that the *principle* is the same, with a little variation in the construction. By placing the steam cylinder lower, or giving the Engine a shorter stroke, and connecting the crank by one pin, they would be made the same. It will no doubt be observed by some of your readers, that allowing an Engine to be made from the drawing, that there is a great objection to its construction; for, suppose before starting, that the cranks were standing in the position as represented in the drawing, they might descend in opposite directions, and drive the paddles contrary to one another, but by a small improvement, the axles could be connected by a rod attached to the traverse spindle (that lifts the valves) from the one which the eccentric wheels are not fixed on, that it might be governed by the one with the eccentrics; and I dare say, many other improvements could be devised by the generality of your subscribers.

After making out the drawing in 1822, I shewed it to some respectable Engine-makers in this city, who had no objection as to its principle; among whom was the late Mr. Robert M'Andrew, an eminent Engineer of the Greenhead Foundry, Glasgow.—I am,

Gentlemen,
Yours, respectfully,
John Stirling.

The Explanation of the Plate.

A, (Fig. 3,) Is the bottom part of steam cylinder, the condenser being connected with it and a brass slide for guiding the piston rod in a perpendicular direction.

B, Cross head of piston rod.

C, C, The side rods bound with the connecting rods

D, D, At the bottom by the pins 2, 2.

E, E, The cranks fixed on the paddle axles G, G.

F, F, Cast iron pillars for supporting the axles.

H, H, The two eccentrics for reversing the motion.

I, I, The eccentric rods for acting on the bell cranks K, K.

L, L, The levers on traverse spindle M, for lifting the valve.

N, The valve casing.

O, The counterbalauce.

P, The communication betwixt the condenser and air-pump.

Q, The air-pump.

R, The crank for working the air-pump.

S, The warm water cistern.

T, The pump for supplying the boiler.

U, The steam pipe communicating with the nozels.

PERPETUAL MOTION.

Gentlemen,—Among the numerous follies which the human mind seeks after, the perpetual motion may be instanced as one. There has been so much labour, time, and ingenuity expended upon it, that there is no hopes of it ever being found out. The great misfortune is, that the different arts and sciences give no countenance to it. Labouring under this disadvantage, there are but few men of a scientific character who do not regard it as a piece of folly and lost labour to pursue after it. It is a common saying, that if the perpetual motion will be found out, it will be found out by a fool, because none but a fool will attempt it. The different changes which the atmosphere is subject to, and the rising and ebbing of the tide might give us a perpetual movement; but for this perpetual movement we are not indebted to man, but to some other superior being.

We should, however, fain hope that the useful knowledge which is so fast spreading amongst us will put away the idea of discovering a perpetual movement, and will make us give that labour and ingenuity to the improvements of the arts, which has been so uselessly spent in searching after an object which, in all probability, never will be discovered.

Among the many who have laboured after this object is your correspondent Mr. Vallance. In your Magazine of 13th May, he has sent you a drawing of an improvement which he has made on his perpetual motion, which, he says, will give it more power. Along with this communication, he has mentioned that I examined his former perpetual motion, and wrongly represented it; although, perhaps, I went into an error in not knowing that the chain did not touch the spokes of the wheel, but only the rolling weights, and the pullies round which it goes, yet this could not alter the principle of the machine; and I again refer him to my letter of 30th November last, where I have mentioned that the rolling weights at the circumference will be met by an equal power, namely, the weights which the chain rises to the centre. If my mistake altered the principle of the machine, then it would be different; but it did not alter it. This Mr. Vallance has not attempted to shew, but has only contented himself by finding fault with my not knowing if his chain touched, or did not touch the wheel, and if the spokes were closed or open at the ends.

It is hardly worth my while to say much about the last drawing of his perpetual motion, which he sent you; he says, it is to have "of course more power," but I believe he is altogether wrong. The alteration merely consists in having angled spokes in place of perpendicular ones, so as to allow the weights to roll out above the centre of the wheel. This I should think can give it no additional power. Suppose for example, his angled spoked wheel to make one complete revolution; it is evident that his twelve rolling weights, will have moved out in succession from the centre to the circumference. Take now his first wheel, which had perpendicular spokes and make it also perform a revolution, and it is evident that his twelve weights will also have moved out in succession to the circumference; so, therefore, if the heaviness of the one weight be the same as the other, the power exerted by them will also be the same, so that no more advantage is gained by the one than by the other. He appears also to think from the angle between the chain and the spoke being less acute than in his former self-acting machine that it will be an advantage. This will no doubt make the rolling weights move with more ease up to the centre of the wheel, but they will have to describe a greater space, as the angled spokes are longer than the perpendicular ones. This Mr. V. might have seen if he would have been at the trouble of applying his rule or compasses. If what has been said, and what you have said yourselves at the end of his communication, does not convince him that he is wrong, we would advise him to be at the expense of a model and tell us what work it performs, before again inserting it in the pages of your useful Magazine.—I remain, Gentlemen,

Your Obt. Servt.

B.

Port-Glasgow, 26th May, 1826.

A MECHANICS' MAGAZINE IN AMERICA.

THE FRANKLIN JOURNAL AND AMERICAN MECHANICS' MAGAZINE.

Devoted to the Useful Arts, Internal Improvements and General Science.

Edited by Mr. THOMAS P. JONES, Professor of Mechanics in the Institute.

We have been kindly favoured by an intelligent contributor with a perusal of this the first Number of the first Mechanics' Magazine which America has produced: and we presume, we need scarcely tell our readers of the unbounded satisfaction with which we hail its appearance. Next to a Mechanics' Institution we hold a well-conducted Mechanics' Magazine, to be the most beneficial method of communicating to the industrious portion of society a knowledge of the sciences and the arts. And we have no hesitation in saying, that with a little more experience, the learned Professor who edits this *work will be able to* make *his labours highly useful.* We observe *with pleasure, the notice* our little work has called forth even in those distant and comparitively uncultivated climes. The able and highly important article by Mr. Bannatyne, which appeared first in our pages, has very properly been extracted into their first Number. It must be productive of incalculable benefits in the new world, as we know to a certainty it has been in the old, and we would recommend it to the notice of the proprietors of large manufactories in America, as an excellent means by which they may further the establishment of similar institutions.

We quote the following from page 41, and will, on the first opportunity which offers, introduce the work again to the notice of our readers.

"In the same number of the 'Glasgow Mechanics' Magazine,' which contains the preceding article, there is the subjoined query. 'If it be true, as philosophers tell us, that it is owing to the porosity of bodies, that they are transparent; how is it, that some bodies, comparatively opaque, (such as common writing paper,) become comparatively transparent, by being laid over with oil? J. B.'

"The magazine was forwarded to a gentleman of this city, by a very distinguished literary lady; who has, under the query, made the following request:—'Pray ask some of your men of science, to reply to this query.'

"To give a popular answer, to a question involving philosophical principles, is always difficult, and frequently impossible; whenever it is attempted, we must suppose the inquirer to be acquainted with the outlines, at least, of scientific knowledge; otherwise, instead of a simple reply, we must give an elementary treatise. Perhaps the following answer may be acceptable.

"Those bodies are denominated transparent, through which light passes readily; this passing of the particles of light depends much more upon the arrangement of the particles of the body than upon its porosity. If we pulverize a piece of transparent glass, the powder will be opaque; yet its porosity will evidently be increased. Opacity and transparency may, therefore, be said to be an accidental state of bodies, in general, and not one of their inherent properties. We are not acquainted with any substance, which is not transparent under some of its modifications; charcoal is transparent in the diamond, and the metals and earths in their solutions *in acids, as* well as in other states *and combinations.*

"*Light, (assuming* its materiality,) is attracted by the particles and masses of other matter: and if this attraction be equal, or nearly so, on all sides, it will pass through the body upon which it falls; and that body will be called transparent: if, on the other hand, it be attracted unequally by the particles of the body, it will obey the strongest force, and its course will be changed; and if this be frequently repeated, it will not pass through, and the body will be opaque. Through a single piece of glass, the light will therefore pass readily, it being attracted equally in all directions, the density of the mass being equal; but if we reduce this mass to powder, although each individual particle will still be transparent, the accumulated particles will not be so; the light in passing near their angles, will be inflected; and in striking upon their sides, will be refracted; and being thus repeatedly turned out of its course will not pass through. If we could now find a fluid of the same density with the glass, or rather one which possessed an equal attraction for the particles of light, and were to pour this upon the powdered glass, we should fill up all the interstices, and in effect, annihilate the angles and surfaces of the particles; the light would again be equally attracted on all sides, and would pass on its course. The effect would be the same as that of pouring in melted glass; or, as remelting the particles, and reducing them again to a single mass. Paper consists of particles entangled and agglutinated together, with numerous refracting and inflecting surfaces; if between them we can insinuate an article, equal in its refracting power to the particles of the paper, it will become transparent; if we approach it only, semi-transparency will be produced, which is all we usually attain."

ON MECHANIC SCHOOLS AND ON POLITICAL ECONOMY AS A BRANCH OF POPULAR EDUCATION.

By Thomas Chalmers, D. D.

This is an able, intelligent, and well-timed article on one of the most important subjects which could possibly come under the attention of its illustrious author. And that it may be rendered no less useful, we trust the spirited and enterprising publishers of the work will adopt every means in their power for its extensive dissemination. We fear there is too much truth, that the opinions of the more wealthy and influential classes, which the Doctor so powerfully and so successfully combats, regarding the education of the people, are gaining ground. Their indifference at least, where open hostility has not been displayed, to the means adopted for attaining this desirable purpose, augurs ill. If they are not throwing barriers in the way to its advancement, they are not lending a willing hand to help the good work forward, and are at least by their coldness and neutrality retarding its progress. But, in many instances, we regret to perceive barriers *have* been thrown in the way. That powerful engine the press—the first and most immediate resort—has been made available to this, the most cruel of purposes. And we have heard it in the senate, from the Bench, to the Bar, and on a recent occasion, by a pious and highly accomplished divine of this city, in the Pulpit, affirmed that the study of science, to the extent which our Mechanics' Institutions would carry it, was a dangerous and impolitic procedure. We would not feel much surprise at an interested politician making this avowal. Enlighten the people, and you endanger the state is his argument—an argument which needs not that it should be answered by us. It is sufficiently absurd, and too easily seen through. But our divine feared the subversion of the church. He argued that men becoming so enthusiastic in their devotion to books of science and scientific pursuits would allow these to encroach on the more important duties which they owe to their Bible and their God. But we are ready to maintain with Dr. Chalmers, "that the most willing attendants on the ministration of a Sabbath are also the most willing attendants on the ministrations of a week-day instructor." And we have no hesitation in saying, that a close examination into society will bear us out in this.

There are several other chapters in this third volume of the Doctor's "Civic Economy," besides the one we mean to avail ourselves of, to which we would also have gladly called particular attention, but our limits do not permit. The following table of contents will, however, shew how highly important those subjects are.

"On the Wages of Labour.—On the Effect of a Poor-Rate, when applied in aid of Defective Wages.—On Savings Banks.—On the Combinations of Workmen for the purpose of raising Wages.—On certain prevalent Errors and Misconceptions, which are fostered by Economic Theories, and which are fitted to mislead the Legislature, in regard to Labour and the Labouring Classes.—On the Effect which the High Price of Labour in a Country has upon its foreign Trade.—On Mechanic Schools, and on Political Economy as a Branch of Popular Education."

We quote *this last chapter entire*, as being one of the most important *essays on the subject which* has fallen into our hands.

"The mechanic schools which are now spreading so widely and so rapidly over the face of our land, must be regarded as a mighty contribution to those other causes, which are all working together for the elevation of the popular mind. But it should not be forgotten, that the scientific education which they provide for *those who choose it*, forms only one of these causes, and that ere we can prevail upon all, or even upon the majority in the working classes of society so to choose, there must have been anterior causes, both of a preparatory and of a pervading nature, in previous operations. We can scarcely expect any demand for a higher scholarship from those who have not been furnished, in some tolerable degree, with elementary learning; and we might farther affirm, with all safety, that the most willing attendants on the ministrations of a Sabbath, are also the most willing attendants on the ministrations of a week-day instructor. However little it may have been reflected upon, it is not the less true, that there obtains a very close affinity between a taste for science, and a taste for sacredness. They are both of them refined abstractions from the grossness of the familiar and ordinary world; and the mind which relishes either has achieved a certain victory of the spiritual or the intellectual, over the animal part of our nature. The two resemble in this, that they make man a more reflective and a less sensual being, than before; and, altogether, impress a higher cast of respectability on all his habits, and on all his ways. It does occasionally happen, that, on entering the house of a mechanic, the eye is pleased with the agreeable spectacle of a well-stored book-case. It is generally the unfailing index of a *well-conditioned* family; and this, *whether it* be loaded with the puritanic theology of our forefathers, or with the popular science of the present day. Now, we are sure that this never can, from an occasional, become a common or a frequent exhibition, but by a process through which our peasantry must ascend to a higher style of outward comfort, as well as to a higher state of mental cultivation. We, therefore, hail the scientific education of the people, as being a most powerful auxiliary towards a translation so desirable; and we are sure, on the other hand, that the cause of mechanic schools will be most powerfully aided, by a greater efficiency being given, both to the methods of common and of Christian education, in parishes. How this can best be accomplished in cities of overgrown population, we have already, with all amplitude, endeavoured to explain; and we barely refer to former chapters of this work, for our description of those processes, by which we conceive that the lessons both of religion and of ordinary scholarship, may most effectually be served out to plebeian families.

"We have also, in part, to make the same reference, that a complete view may be afforded of the estimate in which we hold the salutary operation of mechanic schools, on the circumstances of our general population. We have already made application to this subject of the very obvious truth, that a process of political economy may take effect upon men, who do not understand the steps or *rationale* of the process. It is not necessary, for example, that the philosophy of Malthus should be studied by our common people, ere they shall come under the operation of that moral and preventive check, through which we are taught, by his philosophy, that labourers might attain to a greater comfort and sufficiency than they are now in the possession of. It is not necessary, for this purpose, to read lectures, or to circulate tracts among them, which shall expound the theory of population, in order that they may realize the benefits which would ensue from a right practical application of this theory. The same object is accomplished by the ordinary and general processes, whether of spiritual or of scholastic culture. A lettered and religious population will exemplify the truth of this system, though ignorant of all its doctrines, and therefore totally unacted upon by its authority. Such people have, generally speaking, a self-respect and a self-command—a taste for decent accommodations—a habit of enjoyment, and, therefore, a habit of expense, which demands a higher wage than what can afford the mere homely subsistence of an Irish family. And we have already explained how it is that the demand becomes effective—just by the habit of later and less frequent marriages —a habit to which, without the bidding of any theory, they are naturally led by their own sense of what that is, which makes the adequate and the respectable provision for a distinct family establishment. This stands very palpably out in the custom, at one time nearly universal, of our Scottish peasantry, when, after the virtuous attachment had been formed, and the matrimonial promises had been exchanged, even years of delay were incurred, ere the matrimonial state was entered upon. These years formed an interval of economy and exertion with each of the parties, whose aim it was to provide respectably in furniture, and in all sorts of *plenishing*, for their future household. Here the connection is quite distinct, between a higher standard of enjoyment, and a later period of *marriages. And it* was certainly then by another tuition than that of any economic theory, that a habit, in every way so wholesome, found its establishment among our population. And the exposition of such a theory to the understanding of the people, is just as little needed now, for the purpose either of restoring or of raising this practical habit amongst them. The thing is brought about, not by means of imparting a skill or an intelligence in political economy, but simply by those influences, which give a higher tone to the character ; and of which influences, education may certainly be regarded as one of the most powerful.

"It is thus that mechanics' schools, even though the lessons of economic science should for ever be excluded from them, are fitted to work the greatest of economic improvements in the condition of the people. It is enough that they call for the aspirations of that higher nature, which has so long been overborne by the urgency of their animal wants, and the unchastened violence of their mere animal propensities. Political, it is true, may, like physical science, be addressed to them as an object of liberal curiosity, and simply by the excitement and the exercise which it gives to the mental faculties, it may sublimate the whole man to a more intellectual region than the one he usually breathes in. But either astronomy or chemistry could subserve the same end ; and therefore we repeat, that, though in deference to a general, but ill-founded alarm, the education of workmen in political economy should be kept out of these schools, another education can be devised which shall be fully as effectual for the accomplishment of the most desirable processes in political economy. They might be made to exemplify the principles in which they are not enlightened ; and, without being taught the bearing which a higher taste and style of enjoyment have upon the circumstances of our peasantry, they can be led to imbibe this taste, and so to realize all its eventual benefits. For this purpose, it is not one, but many kinds of scholarship, that are effectual. Whatever may stimulate the powers of the understanding; or may regale the appetite for speculation, by even that glimmering and imperfect light which is made to play, in a mechanic school, among the mysteries of nature; or may unveil, though but partially, the great characteristics of wisdom and goodness that lie so profusely scattered over the face of visible things; or may both exalt and give a wider compass to the imagination; or may awaken a sense that before was dormant, to the beauties of the divine workmanship, and to the charms of that argument, or of that eloquence, by which they are expounded;—each, and all of these, might be pressed into the service of forming to ourselves a loftier population. Every hour that a workman can reclaim from the mere drudgeries of bone and muscle, will send him back to his workship and his home a more erect and high-minded individual than before. With his growing affinity to the upper classes of life in mental cultivation, there will spring an affinity of taste and habit, and a growing desire of enlargement from those various necessities by which the condition of a labourer may now be straitened and degraded. There will be an aspiration after greater things; and the more that he is fitted by education for intercourse with his superiors in rank, the more will he be assimilated to them in a taste for the comforts and the decencies of life. In the very converse that he holds with the lecturer, who one day expounds to him the truths of science, and another day examines and takes account of his proficiency, there is a charm that not only helps to conciliate him to better society, but that also familiarizes him in some measure to the tone of it. This might only proceed a certain way; and yet, however little that way is, it must be obvious, that such a man will not so aptly, or so heedlessly, rush into marriage with no other prospect before him than a potatoe diet for his constant regimen, and one closely huddled apartment for his home. Now, this is all that we want, to relieve the labour-market of the glut which oppresses it, and so to secure a higher wage for our labourers. Towards this result, the mechanic schools lend a most important contribution; and they will speed a most desirable process in political economy, even though they should never initiate so much as one disciple into the principles of the science.

" Still, however, we hold it desirable that this science should be admitted, with others, into our schemes of popular education; and that for the purpose of averting the very mischief which many have dreaded, and which they apprehend still from the introduction of it. To this they have been led, by the very title of our science giving rise to a fancied alliance in their mind with politics; and, in virtue of which, they would liken a lecturer upon this subject, in a school of arts, to a demagogue in the midst of his radical auditory. Now the truth is, that the economical science, which enables its disciples to assign the causes of wealth, is as distinct from politics, as is the arithmetical science which enables its disciples to compute the amount of it; and there is just as much reason to fear an approaching democracy, because the people are now taught to calculate prices, as there will be when people are taught soundly to estimate and to reason upon the fluctuation of prices. We do not happen to participate in the alarm even of those who should, above all things, deprecate, from our mechanic institutions, what might strictly and properly be termed the science of politics, believing, as we do, that all truth is innocent, and that the greatest safety lies in its widest circulation. But we confess a more especial affection for the truths and the doctrines of political economy; and, so far from dreading, do greatly desiderate the introduction of its lessons into all those seminaries which have been instituted for the behoof of our common people. It is utterly a mistake that it cannot be taught there, without the hazard of exciting a dangerous fermentation. Instead of this, we are not aware of a likelier instrument than a judicious course of economical doctrine, for tranquillizing the popular mind, and removing from it all those delusions which are the main causes of popular disaffection and discontent. We are fully persuaded, that the understanding of the leading principles of economical science, is attainable by the great body of the people; and that when actually attained, it will prove not a stimulant, but a sedative to all sorts of turbulence and disorder; more particularly that it will soften, and at length do away those unhappy and malignant prejudices which alienate, from each other, the various orders of the community, and spread abroad this salutary conviction, that neither government, nor the higher classes of the state, have any share in those economical distresses to which every trading and manufacturing nation is exposed; but that, in fact, the high road to the secure and permanent prosperity of labourers, is through the medium of their own sobriety, and intelligence, and virtue.

"But, in confirmation of this our sentiment, we must go somewhat into detail; and, in so doing, shall have to describe the rapid sketch of what we deem to be a right course of popular economics."

ORDINATES OF PARABOLAS CONSTRUCTED FOR DIFFERENT HEIGHTS OF FALL AND FOR DIFFERENT HEADS OF WATER.

GENTLEMEN,—Agreeably to promise, I have sent you a table of the length of Ordinates of Parabolas, for different heads of water, and different heights of fall. Should you think it worth a place in your work, I would be glad you would insert it. From the example given, I trust, it will be sufficiently understood; this I might have sent long ago, but it was only a few days since I got the first quarter of the Magazine for the year.

In No. CVIII. T. A. of Gallashiels, gives a method of finding the length of an arc, corresponding to $\frac{1}{3}$ or $\frac{1}{4}$ of a circle: this I have long been in the habit of doing, but in quite a different, and, I think, more general way; the method I use is as follows:

Mark of a sixth part of the circle (which is done by merely setting off the radius for the chords) divide this sixth into a number of equal parts, corresponding to the required fraction of the whole circle, and 6 of these parts will be the length of the arc, equal to the proportion required. For example, if an eight be wanted, divide the curve marked off by the length of radius into 8 parts, and take 6 of their parts for the length of the required arc; if a seventh, divide it into 7 and take 6, &c.

The reason will be obvious to most of your readers; it is easily seen by stating an example. Suppose a tenth part of the circle were wanted. I said divide the sixth by 10, and take 6 of these which will be the arc sought.

HEADS OF WATER.

Fall in feet	3 feet.	2 feet 9.	2 feet 6.	2 feet 3.	2 feet.	1 foot 9.	1 foot 6.	1 foot 8.	1 foot.
16	9.342	8.953	8.526	8.100	7.635	7.138	6.488	6.037	5.400
15.5	9.195	8.812	8.392	7.972	7.515	7.025	6.386	5.942	5.315
15	9.046	8.671	8.255	7.843	7.392	6.911	6.282	5.846	5.229
14.5	8.894	8 524	8.117	7.711	7.268	6.796	6.177	5.747	5.141
14.	8.739	8.376	7.976	7.578	7.143	6.678	6.070	5.648	5.052
13.5	8.579	8.221	7.829	7.438	7.011	6.555	5.958	5.543	4.959
13.	8.419	8.069	7.688	7.314	6.885	6.437	5.850	5.444	4.870
12.5	8.258	7.915	7.537	7.160	6.749	6.310	5.735	5.337	4.774
12.	8.090	7.753	7.384	7.015	6.612	6.181	5.619	5.228	4.677
11.5	7.920	7.590	7.228	6.867	6.472	6.051	5.500	5.118	4.578
11	7.747	7.424	7.070	6.717	6.331	5.919	5.380	5.006	4.478
10.5	7.567	7.252	6.906	6.561	6-184	5.782	5.255	4.890	4.376
10	7.387	7.080	6.742	6.405	6 007	5.645	5.130	4.774	4.270
9.5	7.198	6.898	6.569	6.241	5.883	5.500	4.999	4.651	4.161
9.	7.006	6.715	6.395	6.075	5.721	5.354	4.866	4.528	4.050
8.5	6.809	6.526	6.214	5.904	5.565	5.203	4.729	4.400	3.936
8	6.606	6.331	6.029	5.728	5.399	5.047	4.587	4.269	3.818
7.5	6.396	6.130	5.838	5.546	5.227	4.887	4.442	4.133	3.697
7.	6.179	5.922	5.640	5.358	5.050	4.721	4.291	3.993	3.571
6.5	5.954	5.706	5.434	5.163	4.867	4.550	4.136	3.848	3.442
6	5.721	5.483	5.221	4.961	4.676	4.371	3-973	3.697	3.307
5.5	5.477	5.249	4.999	4.749	4.477	4.185	3.804	3.540	3.166
5.	5 222	5.005	4.766	4.528	4.268	3.990	3.627	3.370	3.519
4.5	4.954	4.748	4.521	4.296	4.049	3.786	3 441	3.201	2.864
4.	4.671	4.477	4.263	4.050	3.818	3.569	3.244	3.018	2.700
3.5	4.369	4.187	3.988	3.788	3.571	3.389	3.035	2.823	2.526
3.	4.045	3.877	3.692	3.507	3.306	3.091	2.810	2.614	2.330
2.5	3.693	3.539	3.370	3.201	3.318	2.757	2.565	2.386	2.135
2	3 303	3.165	3.014	2.864	2.699	2.523	2.294	2.134	1.909
1.5	2.860	2.741	2.611	2.480	2.338	2.185	1.987	1.848	1 653
1.	2.335	2.238	2.131	2.025	1.909	1.785	1.622	1.509	1.350
.5	1.146	1.116	1.046	.994	.934	.876	.796	.721	.662

CORRESPONDENCE.

Gentlemen,—As most of your correspondents seem so conversant with invention, that they scarce deign a side-look to little men, and little things, will you allow us, who are less cogitative, and less a favourite of invention, still to cultivate the graces of improvement.

South side the Clyde, opposite Broomielaw quay, nature has placed a beautiful green. This green, as every person may know, is divided by three streams, which, with no hasty pace, co-operate to transfer the increase of the Tradeston common-sewers to recoiling Clyde. These streams, gentlemen, from the very nature of their office, necessarily yield a smell the very reverse of fragrant; wherefore, to teach them to trail their charge in a subterraneous course is certainly a *desideratum.* And who will say that the suggestion is unreasonable? hundreds are toiling for toiling sake, and hundreds are still "begging leave to toil." Public charity bestowed for breaking stones is charity hard-earned and barren, but bestowed on public improvement it becomes public property. During the last commercial distress, which by the way threatens to be quinquennial, cognizance has been taken of the public green; and that improvement shall for ever reflect honour upon your city, but we for our own part cannot perceive what just claim *that* has had to melioration that can with impunity be denied *this.* Was that a place of public resort? this is a place of *perpetual* resort. Was that used as a bleaching green? *this* is used as a bleaching green. Was that censured by strangers? Who is stranger then?

L. M'L.

Island of Coll, May 18th, 1826.

MISCELLANIES.

How to clean Old Pictures painted in Oil.—Clean the picture well with a sponge, dipped in warm beer; let it become very dry, and wash it with liquor of the finest gum-dragon, dissolved in fair water. Never use blue starch, which tarnishes and cuts out the colouring, or white of eggs, which casts a thick varnish over the pictures, and only mends bad ones by concealing the faults of the colouring.

New Mechanical Power.—A discovery has been recently made, which bids fair to prove of the utmost advantage as a substitute for steam in propelling engines. The new agent is Mercury; which is capable of existing in a gaseous form at about 600 degrees Fahrenheit. If the alternate rarefaction and condensation of this liquid metal can be effected without undergoing any waste or oxidation, it will probably become a substitute not only for steam, but will afford a simpler mode of communicating power than the new engine of Mr. Brunel by means of the condensation of the gases.

Bell of Notre Dame.—In the southern tower of the Cathedral of Notre Dame at Paris, is the famous bell called *Bourdon,* which is never rung except on great occasions. It weighs thirty-six thousand pounds English. Cast in 1680, and recast in 1686; it was then, according to the absurd fashion of Popish countries, solemnly baptized, or rather blessed; Louis XIV. and the Queen his wife, standing as God-father and God-mother. It received the name of Emmanuel—Louise—Therese. The tongue or clapper weighs nine hundred and seventy-six pounds. This bell is more than three times the weight of Saint Paul's or Tom of Lincoln which are the two largest in Great Britain.

The Ant and the Bee. (Concluded from P. 445, Vol 4.)—The manner in which the young of these insects are severally produced, the fecundity of the females, and the care which is taken of, and the kindness which is exhibited to the young, especially the kindness shewn to the young bees by the working or drone bees, is truly worthy of remark. "They are nurses," says Reanmur, "that have a greater affection for the offspring of others, than many parents have for their own children." We might instance, too, the common interest which seems to unite them at the appearance of danger; the patience with which affront is borne when singly attacked while out of the reach of assistance; and the bravery, and spirit of revenge which they evince when attacked in a body, especially when near their habitation, refusing to retreat from the largest animal, or any number of opponents, till they have spent their fury in retaliating an injury.

"The power of nature," says Dr. Johnson, "is only the power of using to any certain purpose the materials which diligence procures and opportunity supplies;" "and Diligence," says the same learned author, "is never wholly lost. Every class of created existence has certain allotted tasks to perform and ends to attain, diligence and industry in the accomplishment of which seems to be not merely a necessary, but an imperative duty." The irrational insects which more immediately form the subject of this paper, are, or may be, distinguished for their sociality, industry, and economy. So particularly indeed have they been thus distinguished, that the greatest worldly wisdom has recommended them as an example to the indolent and profuse among mankind. Economy is in itself a quality which it is the interest of every individual to practise, for truly has it been said that without this quality none can be rich, while with it very few would be poor. The industrious little insects we have been considering, eminently testify the truth of the above remark: they have no desire to be lavish and extravagant; all their little art centres in providing against the inclemency of the seasons, and for the uprearing of their young. And while they are thus diligent in enriching their stores, the economy which they observe in their manner of living ensures them unfailing means of subsistence.

In whatever shape instruction may be presented to us, whether met with in the page of history, in contemporary adventitious occurrences, or in personal observation, as instruction it is our duty to appropriate its benefits to ourselves in the first instance, as creatures to whom no instruction cannot be useful. Harmony is the order of nature, and is an admirable characteristic in the history of these insects. In many particulars Naturalists differ in their statements respecting these insects, especially respecting the bee; but little difference is apparent in their sentiments regarding the regularity with which their little affairs are managed, and the economy conspicuous in providing and storing up food for future subsistence. They are diligent in their labours, regular in their habits, and provident of their goods—so much so indeed that the greatest human wisdom, in admiring contemplation of the ant, has said, "consider her ways and be wise."—*Curiosus.*

Cherokee Alphabet.—A form of alphabetical writing, invented by a Cherokee named George Guyst who does not speak English, and was never taught to read English books, is attracting great notice among the people in general. Having become acquainted with the principle of the Alphabet, viz. that marks can be made the symbol of sounds, this uninstructed man conceived the notion that he could express the syllables in the Cherokee language by separate marks, or characters. On collecting all the syllables, which, after long study and trial he could recal to his memory, he found the number to be eighty-two. In order to express these, he took the letters of our alphabet for a part of them, and various modifications of our letters, with some characters of his own invention for the rest. With these symbols he set about writing letters, and very soon a correspondence was actually maintained between the Cherokees in Will's valley and their countrymen beyond the Mississippi 555 miles apart. This was done by individuals who could not speak English, and who had never learned any alphabet except this syllabic one which Guyst had invented, taught others, and introduced into practice. The interest in this matter has been increasing for the last two years, till, at length young Cherokees travel a great distance to be instructed in this easy method of writing and reading. They have but to learn their alphabet and they can read at once. In three days they are able to commence letter writing, and return home to their native villages prepared to teach others. It is the opinion of some of the missionaries, that if the Bible were translated and printed according to the plan here described, hundreds of adult Cherokees who will never learn English would be able to read it in a single month. Either Guyst himself or some other person has discovered four other syllables making all the known syllables of the Cherokee language eighty-six. This is a very curious fact, especially when it is considered that the language is very copious on some subjects, a single verb undergoing some thousands of inflections.—*New York Observer.*

Brick Machine.—"It is believed by competent judges," says a Boston paper, "that the brick machine invented at Wiscasset, by J. M. Brookings will entirely supersede the present mode of making bricks." The following is a description of it from the Wiscasset Intelligencer:—

"The mortar is received into a large hopper, where it may be ground fine enough for potter's use; passes into the moulds, which are conveyed through a channel to the hands of the workmen.

The mould is returned to a trough where an apparatus washes and cleanses it with great expedition; it is then placed on the end of the channel, passes under the feeder of the hopper, and out at the other end of the channel, as before described. The whole machinery is moved by a wheel 3½ feet in diameter, which may be turned with ease by a lad of 12 years. It may be adapted to hand, horse, or water power. With hands sufficient to place the mortar in the hopper, receive and return the moulds, one hand at the wheel may mould 30,000 bricks in a day. By water power, the machine may be made to form 100,000 or more, as one turn of the wheel forms a brick. It is placed in a carriage to convey it to different parts of the yard, or elsewhere. The pressing machine is very economical and requires less labour than any thing yet invented. The whole expense of the machine for making and pressing brick (adapted to hand power) will not exceed £30.

American Steam-Boat.—The Trenton is constructed upon an entirely new mode. Her boilers rest upon the guards projecting over the water from each side of the boat. This leaves the deck entirely unobstructed, and forms what may be called a promenade deck. The space usually occupied by the boilers is converted into convenient and handsome dressing-rooms. Should any accident happen to the boilers, the water would be thrown directly into the river, and not in the least endanger the passengers. And what is more important, the annoying degree of heat in the dining-cabins is not felt. She was built at Hoboken; and it may be fearlessly asserted, the improvements in the arrangement and disposition of her machinery are far greater, than any that have been yet made since the first introduction of these boats into our waters.—*Philadelphia Freeman's Journal.*

The Sensative Plant.—Many persons have endeavoured to ascertain the cause of the sensibility of these plants, but it has never yet been clearly explained. The degree varies in the different kinds; some will only contract their leaves on being touched; others will bend and recede, as it were, courteously, to acknowledge your approach; as that which is termed the humble plant,

> ——" That courteous tree,
> Which bows to all who seek its canopy."
> *T. Moore.*

The most irritable part of the plant is in the foot-stalk, between the stem and the leaflet. During the night, they remain in the same state as when touched in the day-time; yet if touched then will fold their leaves still closer.

When any of the upper leaves are touched, if in falling they touch those below them, those will also contract and fall; so that, by touching one another, they will continue to fall for some time.

It is very common in the woods of Brazil: of one of the species, of which the wood is very light, the Indians make their canoes.—*Flora Domestica.*

Remarkable Spring.—At twelve miles distance from Tallahassee, the new capital of Florida, is the big spring, the source of Wakulla river. This celebrated fountain is one of the greatest natural curiosities in the United States. Ascending the river, about one mile below its source, it becomes so much obstructed by flags and river weeds, that it is with great difficulty that a boat can be propelled up the stream; suddenly this immense spring breaks upon the eye. It is nearly one mile in length, and of a circular form. The water is almost as transparent as air itself. It is of an unfathomable depth which gives the water a deep blue tint, similar in appearance to the water in the gulf stream. It is stated that a plumb has drawn 250 fathoms of line without finding any bottom. After arriving in the centre of the spring in a small boat upon a clear day the appearance of the azure vault above, and the blue depth below gave rise to a succession of the most singular ideas. It appeared after abstracting the surrounding foliage from the mind that we were suspended in the immense regions of space. The water is highly impregnated with decomposed limestone, which gives it that extremely transparent appearance which can only be accounted for by supposing that water impregnated with calcareous substances has much less refractive powers for light than water in a state of purity. The temperature of the water is very low. Even in the warmest weather it has an icy appearance. It has however a nauseous taste by being highly impregnated with the sulphuret of lime. On the northern side of this spring, a beautiful hammock rises gently from the waters. This is the side of the former English factory for the Indian trade, while this country was under the British crown, and afterwards the residence of the celebrated Ambrister, who was executed during the Suninole Campaign. This fountain is fed from the subterranean sources which gush from the bowels of the earth with incredible force, rising in the centre with the velocity of boiling water. Some idea may be formed of the power with which it gushes from the earth by its displaying a column of water more than 250 fathoms in height and removing with violence the surface. This spring is about 12 miles from St. Marks, and about 20 from the ocean.—*American paper.*

Animal Bodies Preserved from Putrefaction.—Amongst the most remarable curiosities in the city of Bremen is the extraordinary and singular property of a vault in the cathedral, by which bodies are preserved in the same manner as if they were embalmed. This vault is 60 paces long, and 30 broad. The light and air are constantly admitted to it, by three windows, though it is several feet beneath the ground. Here are five large oak coffins, each containing a body. The most curious and perfect is that of a woman, said to be an English countess, who, dying in Bremen, ordered that her body should be placed in this vault, expecting that her relations would cause it to be carried over to her native country. However, it has remained here 250 years. Though the muscular skin is totally dried in every part, yet so little are the features changed, that nothing is more certain, than that she was young and even beautiful. It is a small countenance, round in its contour, the hair as light and glossy as that of a living person. In another coffin is the body of a workman who fell from the top of the cathedral and was killed instantly. His features shew this most forcibly. Extreme agony is marked in them, his mouth is wide open, and his eyelids the same, the eyes are dried up, his breast is unnaturally distended, and his whole frame betrays a violent death.

Directions for Varnishing.—In varnishing, the work must be made clean from grease, wax, &c. and made blood warm by the fire; after which, and while the work is still warm, give it one coating of varnish; then let it dry, which it will soon do, and warm it, again repeating the coating and warming, until it shine. If it stands half an hour, and another coating wanted, it will be the better; another warming will also at the same time be required, as above.

Instinct.—One of the most curious instances of the ingenuity of animals for self-preservation is that related of the dogs and cattle in South America, which bark and low on the side of the rivers, to attract the alligators. When they have brought them to a particular spot, they immediately run to another, and drink rapidly, lest they should be dragged into the stream, and devoured by these voracious monsters.—*Curiosus.*

Portable Pendulum.—For civil and military engineers, and other practical men, it is highly useful to have a portable pendulum, made of painted tape with a brass bob at the end, so that the whole, except the bob, may be rolled up within a box, and the whole enclosed in a shagreen case. The tape is marked 200, 190, 180, 170, 160, &c. 80, 75, 70, 65, 60, at points, which being assumed respectively as points of suspension, the pendulum will make 200, 190, &c. down to 60, vibrations in a minute. Such a portable pendulum may be readily employed in experiments relative to falling bodies, the velocity of sound, &c. The pendulum and its box may go into a waistcoat pocket.—*Dr. Gregory's Practical Mechanics.*

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

Published every Saturday, by W. R. M'Phun, 86, Trongate, Glasgow, to whom
Communications (post paid) must be addressed.

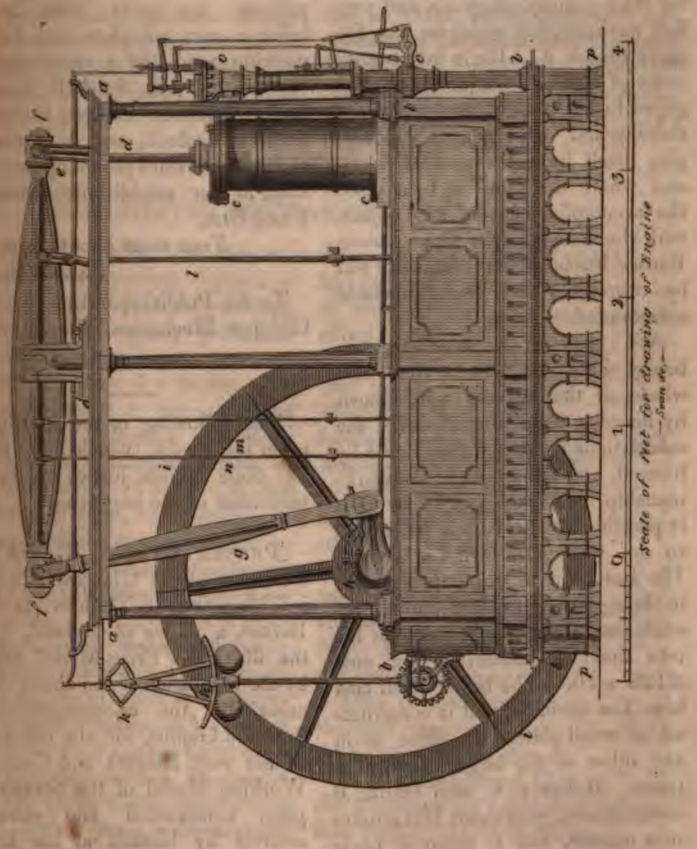
AITKEN, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

" The price of wisdom is above rubies."—*Job.*

No. CXXIX. *Saturday*, 10*th June*, 1826. Price 3*d*.

STEAM ENGINE.



Vol. V.

THE STEAM ENGINE,

WHICH occupies our plate this week, is a drawing of the model of the one, to which the prize of Five Guineas and the Silver Medal which we offered in our III. Vol. page 144, has been awarded. It is one of the most complete pieces of Machinery, and at the same time, one of the most elegant which we have ever seen. And the young man who has been at the labour and expense of constructing it, merits the highest praise for the ingenuity, elegance, and perfect workmanship which he has displayed upon it. He is but twenty years of age, and has only been engaged in his present occupation for three years. But genius will display itself from the earliest years, and where the mind is bent upon the accomplishment of any object, with the same intensity which young Barnes' has been, every difficulty will be overcome, and every obstacle surmounted.

We have great satisfaction in being able to state, that the whole of the patterns were drawn by his own hand, the whole of the calculations necessary were made by himself, and the whole of the workmanship, fitting up, &c. so far as it is possible for any single individual to do, was performed by himself. He has been at immense expense in bringing it to perfection, for, exclusive of any charge made for his own time, the materials, &c. cost £128 „ 10. The boiler itself cost him Ten Guineas, and is constructed of small plates, the same as in any other of the larger engines in town. It has a 6 inch crank, 6 inch cylinder, goes about 108 strokes in a minute, and is about $\frac{1}{3}$ horse power.

We have to express our gratitude to the gentlemen who so kindly have lent their time and attention to investigate into the merits of the claimants, and or their satisfaction, we beg to introduce the following letter, with which Mr. Cook has favoured our publisher.

SIR,—It gives me great pleasure to certify, that the very elegant specimen of work, sent in competition for your fifth prize, being a very complete and highly working model of a steam engine, constructed and finished entirely by Mr. Thomas Addison Barnes, a native of Ireland, and is at present serving in his third year of apprenticeship, in our establishment here.—I am, SIR,

Your most obedt. servt.

JAMES COOK.

To the Publisher of the
Glasgow Mechanics' Mag.

Tradestown, Glasgow, 20th May, 1826.

The following is the inscription upon the medal, which Mr. Swan has done infinite justice to in the execution of the engraving.

PRESENTED by W. R. M'Phun, Publisher of the Glasgow Mechanics' Magazine, to Thomas Addison Barnes, a native of Ireland, being the fifth class Prize Medal, offered by the Publisher of the above Magazine, for the encouragement of Juvenile Genius, for the exhibition of his very Elegant and Complete Working Model of the Steam Engine, constructed and executed entirely by himself at his leisure hours during the third year of his

ticeship with James Cook,
ɛer, Glasgow, 1825.--Award-
Dugald Bannatyne, Esq.
stie, Esq. James B. Nelson,
nd James Cook, Esq.

---

escription of the Plate.

t, *b*, *b*, *b*, *b*, is the frame
made of cast iron, and fasten-
ether with bolts; the under
b, *b*, *b*, forms a cistern, con-
the air pump and condenser,
t and cold water pumps, and
ppendages.
is the steam cylinder. *d*, the
rod, which gives motion to
rking-beam *f*, *f*, being con-
to it by the straps *e*. These
straps form part of the parallel motion which is mostly hid by the framing. *g*, the connecting rod. *h*, the crank. *i*, *i*, the fly-wheel. *k*, *k*, the governor, which regulates the engine. It is driven off the crank shaft by means of wheel work. *l*, the rod which works the air-pump *m*, the hot water-pump rod. *n*, the cold water-pump rod. *o*, *o*, the nossels, wherein the valves are placed for admitting the steam to and from the cylinder. The nossels are supported by two columns one of which serves as a pipe for conducting the steam from the boiler. *b*, *b*, *p*, *p*, a stand made of cast iron, on which the whole rests.

MANCHESTER MECHANICS' INSTITUTION.

ST the gloom and despon-
which the present depression
nercantile world has produced
amid the many privations
hich the operatives are now
d down, we feel highly gra-
n having it in our power to
ice the following interesting
t of the flourishing state of
stitution. The thirst for
dge is great, and rapidly in-
g, and the means resorted to
communication of this know-
o the industrious classes is no
asing. The conduct of these
nen, who have voluntarily
orward and delivered gratuit-
course of lectures, is deserv-
highest praise, and we trust
bour shall neither be in vain,
s over unrewarded. We should
uch to see a little more of this
f giving these voluntary and
ous lectures introduced in
quarters. In this city, where
there are so many fully competent for the task, and when the funds of the Institutions cannot well afford to lay out a heavy sum annually for a lecturer, we would like to see some of our learned Mechanics' and Chemists coming forward to lend their aid. The Manchester Institution has commenced building a hall for themselves. £6600 has been already subscribed for this purpose.

At the second Annual Meeting of the Honorary Members, held at the Library, in Cross-Street, on 2d May, ROBERT PHILIPS, Esq. in the chair, a Report from the Directors, of their proceedings during the past year, was read, of which the following is an abstract.

It is with sincere pleasure that the Directors are enabled to lay before you a Report confirmatory of their favourable anticipations at your last meeting. The Institution is now in active operation. The number of subscribers is 621, of which a classification according to their several trades is annexed.

The Library, during the last year, has been largely increased by donations and purchases of books. The sum expended in that period, on this important branch of the Institution, is £170; and the Directors have the satisfaction of knowing, that under the judicious superintendence of a Select Committee of their body, to whom the purchases have been entrusted, much advantage has accrued to the Institution, both in the selection and the cheapness of the books. The number of volumes now in the Library is 1323, of which 690 are donations. The interest which the Subscribers take in the library and reading-room, is very gratifying, the latter continues to be fully attended: and in addition to the books there read, the aggregate number of books delivered to the Subscribers during the year, to be read at their own houses, is 8154, of which a more detailed statement is annexed. Shortly after the termination of Mr. Wilson's lectures on mechanical philosophy, (which were in progress at your last meeting.) Mr. Philips commenced his admirable course on chemistry—his scientific attainments—and his rare qualifications as a public lecturer, are well known; and these, his first lectures in Manchester, excited the liveliest interest. He ingratiated both himself and his subject with his numerous audience, by his entire freedom from all parade of science, by the clearness and simplicity of his explanations, and by the brilliancy and success of his experiments; and the directors are persuaded, that his course was materially beneficial in advancing the interests of our infant Institution.

Mr. Phillip's lectures were succeeded by a gratuitous course from Mr. Thos. Ashton, (a gentleman of the medical profession, in much estimation here,) "on the conformation of man, and his relation to the objects by which he is surrounded," a subject which the Directors concurred with Mr. Ashton, in considering important in connection with the objects of the Institution;—the lectures were enlivened by many valuable and striking illustrations, and gave much satisfaction. Not only did Mr. Ashton, in the handsomest manner, decline all remuneration for his services, but he would not even consent to allow the Institution to defray the necessary charges he had himself incurred.

At the close of Mr. Ashton's Lectures, the Directors succeeded in prevailing upon their colleague, Mr. Davies, to deliver a course of Lectures on Natural Philosophy; these excellent lectures are now in progress;—they were prefaced by some admirable observations on the benefits of Mechanics' Institutions, which in each succeeding lecture, receive acknowledged and ample illustration.

The Directors have annexed to their report a syllabus of the several courses of lectures which have been delivered.

In pursuance of the plan marked out at the commencement of the Institution, a School has been established for the instruction of the Subscribers in Arithmetic and Mathematics: two classes have been formed, one for students in Arithmetic, and the other for those who are prepared to commence Geometry and Algebra. The classes meet

reading-room for two hours
Tuesday and Wednesday
g; they are under the super-
ence of four of the Subscrib-
viz:—Messrs. John Hill,
t Smith, James Turner, and
el Cottam, who in the most
ome manner, offered their
ous services as teachers; their
or attainments well qualify
for the office, and the Direc-
ke this opportunity of express-
e satisfaction they have deriv-
m their labours. They ren-
the Directors quarterly, a re-
f the proceedings of the class-
eir reports will be laid before
ogether with the rules of the
, and the mode of teaching
d. You will observe, that
eports bear gratifying testi-
o the industry and progress
students. It is to be regret-
at a greater number of the
ibers had not availed them-
of the advantages of these
The Directors would ear-
rge upon their consideration
ark of Mr. Dalton, in refer-
the lectures, that "Where
chanical and Chemical Arts
iences form a primary object
uit, it is highly necessary for
vho attend the lectures, pre-
to acquire a good knowledge
metic, and to be in some
acquainted with the Ele-
of Geometry and Algebra,
se the lectures cannot impart
nstruction, though they may
afford some amusement."
y of the Subscribers having

expressed a wish to be instructed in the Mechanical and Architectural Drawing, a School for this purpose is now forming. The Directors have engaged at a rental of £20, per annum the rooms over the Library and Reading-room, one of which will be appropriated to this class —and in the others the apparatus belonging to the Institution will be deposited.

In the formation of the Elementary Schools, the Directors have particularly to acknowledge the valuable assistance they have derived from various detailed communications on the subject from the Committee of the London Mechanics' Institution, whose ready co-operation on this and on other occasions demands their best acknowledgments.

It has been the wish of the Directors to adopt some plan for the encouragement of merit among the students, and also for the encouragement of invention and discoveries, by conferring honorary or pecuniary rewards on those individuals who may present them to the Institution. The Directors appointed a Select Committee of this body to draw up a plan for this purpose;—the report of this Committee will be laid before you; it is a very able and important document, but the Directors have not yet had the opportunity of giving it the consideration necessary before they can decide upon all the details of the mode in which this most desirable object should be carried into effect.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

SECTION III.

3. *Washing.*—It is never to be forgotten that between each of the several processes of steeping, bucking, souring, &c., the goods are to be thoroughly washed by the dash wheel in pure water, so that all the loosened impurities, as well as the detergent which has been employed, may be effectually removed. When any of these are left through defect of washing, they not only prevent the proper operation of the agents afterwards applied, but often leave in the cloth indelible stains. Besides, as it may through neglect become dry after bucking or souring, the salts will be condensed in proportion to the dryness of the cloth, and acting with greater force will destroy its texture. Soap is not employed except in the first washings and in finishing. Black or soft soap is found to be best for these purposes; brown soap leaving a yellowish tinge on the cloth. If these precautions are not attended to, the goods which are imperfectly washed will be in danger of becoming yellow instead of white, by immersion in preparations of chlorine; and even of acquiring a tenacious and disagreeable ruddy tinge, either partially if the washing has been partial, or totally if it has been entirely neglected. The bleacher should be on his guard, not to soap cleared goods in the soapy solution which has been used for pieces taken out of a strong chlorine preparation, even though they have first passed through a sour of sulphuric acid. For this soapy solution does not fail to acquire the property, of discolouring other goods, unless the goods which were soaped, after being taken out from the chlorine preparation, have been immersed for a long time in clear water. Washing should always if possible be performed *immediately* after bucking, while the goods are yet warm, as the filth and refuse will then be easier removed than after they become cold.

4. *Crofting, or exposure on the Field.*—It has been accounted a great desideratum in bleaching to find a method of finishing goods without exposing them on the bleach-green; as it consumes a great deal of time and labour, and keeps out of cultivation large tracts of good arable land. It was thought, at one time, that the introduction of chlorine bleaching would supersede crofting, and it would do so in a great measure, were it practicable to apply it in a proper manner. But, however great may be its facility in bleaching, it is scarcely possible to adopt it in an extensive manufactory to the exclusion of crofting, without very heavy charges in work-shops and apparatus. This naturally follows from what has already been remarked with regard to finishing the bucking process; and it is useful to take notice of it, as bleachers often let their goods lie in heaps for a considerable time before washing. The washing of goods after souring is sometimes admitted on the erroneous notion that the acid which adheres to the cloth

is useful in giving activity to the oxymuriatic salts. Evils of which they are unaware, arise from this mode of management. For when the sulphuric acid thus left in the cloth meets with lime, it forms a sulphur, which becomes fixed in the pores of the cloth, and produces stains that crofting cannot remove. The prevalence of this may be seen by examining the kiers which are often covered on the inside with this pernicious sulphate; it can therefore only be economically adopted with such goods as are intended to receive what is called a half, or three-quarter white. It has certainly very much diminished the period which crofting was wont to require, and in this seems to consist the chief difference between the old and the new modes of bleaching.

The first thing which claims attention, is the soil and situation of the bleach-green. A gravelly or sandy soil seems to be the best, as the water will pass quickly through a soil of this kind, and will increase the reflection of the heat, for the process depends on the evaporation which may thus be caused. For the same reason it ought to have a southren exposure, and if possible should rather be sloping than level. To prevent the water from becoming muddy, it should run in a channel paved with sand-stone.

When the cloth has been steeped and bucked, it is spread out on the field, and frequently watered for the first six hours, to prevent the condensation of any alkali which the washing may not have removed. Dry spots are then allowed to appear before any additional watering. Dr. Home thinks that it profits most by this exposure when near drying, as the evaporating particles come rather from the more internal parts than the surface, and that it is chiefly evaporation which operates, is inferred from the face, that the upper is uniformly whiter than the under surface. That it loses together with its greyish tinge the remainder of the acids and alkalies, with which it has been treated, appears from the safety with which it may be afterwards dried. Soap when sliced down and exposed to the sun and air, with frequent waterings, will lose half its weight in a fortnight; the inference is obvious and need not be stated. From some experiments it appears that the sulphur of the leys is one of the substances which is evaporated in crofting, and we know that this always has a tendency to produce a yellow tinge. (See Trans. R. T. Acad. III. p. 45.) Berthollet seems to have taken a view of this process not quite so scientific as might have been expected, when he tells us (Ann. de Chim. II.) that crofting only prepares the colouring particles from being afterwards dissolved and separated by the ley. He surely never had observed the peasants bleach, nearly by crofting alone, or by crofting *after* boiling in alkaline or soap leys.

It is supposed by bleachers, that exposure on the field has more effect in the months of March, April, and May, than in any of the other months. As this idea is universal, it is likely well-founded, although Dr. Home has endeavoured to account for it by the greater attention which is usually paid to goods at the beginning of the bleaching season. He states also that Mr. Christie, an experienced and enlightened bleacher, found the summer and autumnal months to be more efficacious than those of spring. But may not the draught prevalent in March, produce such an effect if evaporation is the agent? And if light, as seems indubitable, is requisite, will not the want of clouds at this time be of consequence? The effect of light on colours is often very striking. When I was in Ireland, I observed that the bed curtains in the rooms of Shane's castle, which are exposed to the reflection of light from Loch Neagh, were changed from fast and brilliant colours, to pure white. Baume (Journ. de Physique 1793) found that yellow raw silk, loses its colour in a short time, by exposure to the sun, (see a memoir on this subject, Ann. de Chim. VI. 80.) Berthollet imagined that there might be something in dew which was efficacious in crofting, and he accordingly examined the dews which fell at different periods of the night. He found them (Ann. de Chim. II.) so strongly impregnated with the principle of acidity, that they destroyed paper tinged with turnsole. From this he accounts for the greater efficiency of spring dews, on the erroneous doctrines that dew is transpired from plants, and that plants transpire oxygen and dew most copiously in spring. That the sun has a considerable effect in whitening, independent of evaporation, appears from this, that in dry windy weather the evaporation is more speedy, but the bleaching is slower than in calm sunshine, which seems to be the best weather for crofting. Dr. Home thinks however that is in consequence of the slowness of the evaporation coming more from the internal parts of the goods, this he thinks must be the case, in consequence of the heat tending to open the pores, while the wind will rather close them. The same intelligent chemist remarks, that it is in consequence of its completing the bucking process by evaporating the salts which are combined with the loosening impurities, that crofting proves beneficial; no sort of washing which he tried as a substitute, was found capable of superseding the process, crofting always follows every bucking and boiling. There are, strictly speaking, two modes of crofting: the goods are artificially watered from troughs or little canals; or, they are exposed to all the vicissitudes of the atmosphere, without artificial watering. The latter is called dry crofting.

5. *Boiling.*—Coarse linen cannot afford the time and labour, but particularly the quantities of alkali necessary for bucking, and must undergo the shorter and more active operation of boiling. Although however it may seem to be the more active process, it by no means follows that it is the most efficacious; on the contrary, the ley is much thicker and darker after bucking than after boiling. As the heat continues longer at the degree of boiling, the leys used for the coarse cloth must be weaker than those used for the fine. There is not so much danger from heat in the coarse as in the fine cloth, because the former is of more open texture and will allow the ley to penetrate more speedily; but in the coarse cloths of a more close texture, the heat should be raised gradually to the boiling point. The effect of boiling raw cotton or linen in a diluted solution of caustic alkali, is to give the liquors a deep brown colour and to destroy its causticity; and fresh portions of clear ley applied a second or third time will produce similar

effects, but in an inferior degree. (Recs' Cycl. Bleaching.)

In bleaching fine goods, boiling is among the finishing operations, and is only employed when the goods are nearly white in order to remove the disagreeable smell of the preparations. The ley in this case is composed of pearl ashes, or of pearl ashes and white soap. The boiling ought not to be urged with a brisk fire but just kept barely at the boiling point. The goods must be completely covered with the ley, and kept from rising by a cross similar to that used in steeping, in order that they may be exposed equally to the action of the alkali or soap. In bleaching fine cottons such as lawn grounds, books, and light jaconets no pearl ashes are used, the ley being made wholly of soap.

6. *Immersion in the preparations of Chlorine.*—When the oxymuriates of lime, potash, soda, or magnesia have been prepared in the way already directed, they are to be diluted to the specific gravity of 1005, or 6 or 8 quarts of the solutions may be mixed with 20 gallons of water, and put into the immersing apparatus of Rupp or any other which may be thought best. The test liquors already so fully described are then to be had recourse to, to check the indication of the specific gravity. Mr. Dalton's certainly seems to be the best, but where this is not at hand solutions of indigo-cochineal, or turnsole may be used, even red-wine is no despicable test, when the others can not be had. It may be useful to take notice of the several colours which these test liquors acquire when the chlorine preparations are of sufficient strength. Dalton's tests have already been copiously explained. The indigo test becomes yellowish passing into wood and more of a deeper or fainter tint in proportion to the darkness of the blues, the tincture of cochineal becomes dutch orange; red-wine becomes wine yellow; and infusion of turnsole becomes amber brown. The goods are to be immersed in the liquor immediately on being removed from the bleach-green, and particular care ought to be taken that they be all equally exposed to its action, otherwise stains and spots may be produced which subsequent treatment may not be able to remove. Twelve hours is the usual period allotted for the immersion of linens; but less time will sometimes be sufficient. The bleaching liquors according to Mr. Roe's experiments may be repeatedly used without detriment till their whole strength be exhausted. *(Dublin Report,* 1791.*)*

GLASGOW MECHANICS' INSTITUTION.

Distribution of Prizes.

SEVERAL new features have appeared in the plan of instruction, which has been adopted this past winter in the above Institution, which we hesitate not to say, are of the very first importance, and therefore are worthy the attention and practice of other similar establishments. To one of these novelties, namely, the inculcation of scientific knowledge by conversations, examinations, and actual practice, we have already adverted; and we now take the liberty to direct the attention of our readers to another, nearly equal in importance, the introduction of Prize questions, in addition to a numerous diversity of ordinary exercises. At the commencement of the season, Mr. Deuchar volunteered a lecture to raise a fund for a number of premiums to be awarded for the best essays, and solutions, written by the members on any of the Prize subjects given out during the winter. The money thus procured was expended in a selection of the most useful works upon chemistry, mechanics, and their applications; and, through the liberality of our publisher, these were rendered more numerous than they otherwise could have been, by his refusing to take the ordinary trade profit on the books thus to be awarded. To the numerous display of premiums, arising from the above lecture, Mr. Deuchar himself added also two handsome works, the one of them to be voted by his class-mates, to the greatest proficient at the conversation-class, and the other to be given to his assistant Mr. James Syme, for the satisfactory manner in which he filled that situation.

We have already given an account of the Premiums which fell to the share of the conversation-class; and we now proceed to lay before our readers, the names of the rest of the successful candidates, for the honours held out to them.

The best Essay on "the Chemical Arts," was written by Mr. Ebenezer Forbes, of Dalmarnock Dye Work, and displayed no ordinary talent and research on the part of the writer.

The second best Essay, and also a very good one, on "the Chemical Arts," was by Mr. Robert Lyon Harrower, a native of Fyfeshire, and a student of medicine at the Glasgow University.

The best paper on the motion of Camphor, was by Mr. William Fairservice, 88, Gallowgate.

The best Essay on "the Mechanical Arts, and to shew in how far they have been benefited by science," was by Mr. Robert Lyon Harrower.

Besides the above two Essays, Mr. Harrower also gave in solutions of twenty of the ordinary questions given out during the winter; and the announcement of a Prize to him on this account, was received with great applause by his fellow members.

The subjects written on by Mr. Harrower, were, 1. Phenomena of the Water Hammer. 2. The narrow necked Water Hammer. 3. Characteristics of Chemical and Mechanical action. 4. Theory of the Syphon. 5. General results of Chemical action. 6. Why do we call a body light? 7. Nature of the Vaccuum produced by the Air pump. 8. On Gravitation. 9. On Capillary motion. 10. On Mechanics. 11. On Chemistry. 12. Properties of Matter. 13. Division of Camphor. 14. On the Cryophorus. 15. Cause of the cold in freezing mixtures. 16. On steam at 212° and 230°. 17. Coldness in upper regions. 18. Pressure of whole atmosphere. 19. Guinea and feather experiment. 20. Cork and gold weighed in vacuo.

A Premium was awarded to Mr.

James Groves, of the University Printing Office, for a very ingenious application of the syphon to cool a Refrigeratory, of which we expect to be able to give a sketch in some future number.

A Premium was assigned to Mr. Edward Cundel, for various improvements in mechanics, some of which he had applied to practice.

Various lesser rewards were granted to the following members: to Messrs. William Barr, R. M'Auley, R. L. Harrower, John M'Conachy, Dugald M'Dougall, and William Sawers, for papers, on "the Minute Division of Camphor."

To Messrs. Neil M'Lardy, R. L. Harrower, Robert Walker, W. Sawers, Robert M'Farlane, John Donaldson, and R—— P——, for papers on "the Weight of the whole Atmosphere."

To Messrs. Neil M'Lardy, William Patterson, and C—— W——, for papers on "the Lever."

To Messrs. John Crawford, and R. L. Harrower, for papers on "Attraction."

To Messrs. John Grant, and R. L. Harrower, for papers on "Dr. Wolaston's "Cryophorus."

To Messrs. R. Duncanson, and R. L. Harrower, for papers on "the Guinea and Feather experiment."

To Messrs. W—— F—— and R. L. Harrower, for papers on "the Proportions of Matter."

All of these rewards were accompanied by suitable titles, descriptive of the merits of the respective individuals to whom they were given, which were signed by the President, Secretary, and Lecturer; and we are confident, that these well merited testimonials of their scientific attainments, will be treasured up as proud memorials by those who have acquired them.

COHESION,

One of the four species of attraction, denoting that force by which the parts of bodies adhere or stick together.

This power was first considered by Sir Isaac Newton, as one of the properties essential to all matter, and the cause of all that variety we observe in the texture of different terrestrial bodies. He did not, however, absolutely determine that the power of cohesion was an immaterial one; but thought it might possibly arise, as well as gravitation, from the action of another. This account of the original constitution of matter is as follows: It seems probable, that God in the beginning formed *matter* in solid, massy, impenetrable, moveable particles; of such sizes, figures, and other properties, and in such proportion to space, as most conduced to the end for which he formed them: and that these primitive particles being solid, are incomparably harder than any porous bodies composed of them: even as hard as never to wear or break in pieces; no ordinary power being able to divide what God himself made one at the first creation. While the particles continue entire, they may compose bodies of one and the same nature and texture in all ages; but should they wear away, or break in pieces, the nature of all things depending on them would be changed. Water and earth, composed of old worn particles, would not now be of the same texture, with water and earth composed of entire particles in the beginning. "And, that nature may be lasting, the changes of corporal things are to be placed in the various separations and new associations and motions of these permanent particles; compound bodies being apt to break, not in the midst of solid particles, but where these particles are led together, and touch in a few points." It seems farther, "That these particles have not only a *vis inertiae*, accompanied with such passive laws of motion as naturally result from that force; but also that they are moved by certain active principles, such as that of gravity, and that which causeth fermentation and the cohesion of bodies. These principles are to be considered not as occult qualities, supposed to result from the specific forms of things, but as general laws of nature by which the things themselves are formed; their truth appearing to us phenomena, though their cause is not yet discovered.

The general law of nature, by which all the different bodies in the universe are composed, according to Sir Isaac Newton; *i. e.* "Every particle of matter has an attractive force, or a tendency to every other particle; which power is strongest in the point of contact, and suddenly decreases, insomuch that it acts no more at the least sensible distance; and at a greater distance is converted into a repellent force, whereby the parts fly from each other. On this principle of attraction may we account for the cohesion of bodies, otherwise inexplicable.

"The smallest particles may cohere by the strongest attractions, and compose bigger particles of weaker virtue; and many of these may cohere, and compose bigger particles, whose virtue is still less; and so on for divers successions, until the progression end in the biggest particles, on which the operations in chemistry, and the colours of natural bodies depend; and which, by cohering, compose bodies of a sensible magnitude. If the body is compact, and bends or yields inwards to pressure without any sliding of its parts, it is hard and elastic; returning to its figure with a force arising from the mutual attraction of its parts. If the parts slide from one another, the body is malleable and soft. If they slip easily, and are of a fit size to be agitated by heat, and the heat is great enough to keep them in agitation, the body is fluid: and if it be apt to stick to things, it is humid; and the drops of every fluid affect a round figure by the mutual attractions of their parts, as the globe of the earth and sea affects a round figure from the mutual attraction and gravity of its parts.

"Since metals dissolved in acids attract but a small quantity of the acid, their attractive force reaches but to small distance. Now, as in algebra, where affirmative quantities cease, their negative ones begin; so in mechanics, where attraction ceases there a repulsive virtue must succeed. That there really is such a virtue seems to follow from the reflections and inflections of the rays of light; the rays being repelled by bodies in both these cases without the intermediate contact of the reflecting or inflecting body. The same thing seems also to follow from the emission of light, a ray, as soon as shaken off from a body by the vibrating motion of the parts of the body, and got beyond the reach of attraction, being driven away with exceeding great velocity; for that force which is sufficient to turn it back in reflection may be sufficient to emit it. From the same repelling power it seems to be that flies walk upon the water without wetting their feet; that the object-glasses of long telescopes lie upon one another without touching; and that dry powders are difficultly made to touch one another so as to stick together, without melting them or wetting them with water, which, by exhaling, may bring them together.

"The particles of all hard homogeneous bodies which touch one another, cohere with a great force: to account for which, some philosophers have recourse to a kind of hooked atoms, which in effect is nothing but to beg the question. Others imagine, that the particles of bodies are connected by rest, *i. e.* in effect by nothing at all; and others, by conspiring motions, *i. e.* by a relative rest among themselves. For myself, it rather appears to me that the particles of bodies cohere by an attractive force, whereby they tend mutually to each other."

From this account of the formation and constitution of bodies, we can conclude nothing, except that they are composed of an infinite number of little particles, kept together by a force or power; but of what nature that power is, whether material or immaterial, we must remain ignorant till farther experiments are made. Some of the Newtonian philosophers, however, have positively determined these powers to be immaterial; in consequence of this supposition, they have so refined upon attractions and repulsions, that their systems seem not far from downright scepticism, or denying the existence of matter altogether.

SCIENTIFIC CORRESPONDENCE.

IMPORTANT IMPROVEMENT ON THE STEAM ENGINE.

GENTLEMEN,—Being on a visit to the Metropolis for the purpose of gaining information on some of the late patented improvements in Mechanics, I have, of course, endeavoured to hear and see every thing new connected with that science. Amongst the most prominent inventions is that of an American, a Mr. Joseph Eve, of a very simple rotatory steam engine, with a new boiler, and various other very ingenious contrivances, the particulars of which I have seen to day published in a weekly periodical, called "the Register of Arts and Sciences."

The invention occurs to me to be considered amongst my friends, as the most important since Mr. Watt's improvements, and, it is thought, will form a new era in Steam-engineering. As far as my judgment goes, I cannot but agree with this opinion, and fear, Mr. Eve's engines will supersede the cylinder engines in the course of time altogether.—It is said, Mr. Eve has an engine now constructing, which will be finished in a short time. If I do not return to Glasgow before, it is finished I shall certainly endeavour to see it, and will with pleasure inform you of its performance. In the mean while you will no doubt give publicity to this invention in your highly respectable Magazine, of which I am a constant reader,

Yours respectfully,
A Glasgow Mechanic.

London, June 3d, 1826.

[We will endeavour to furnish our readers, in the mean time, in an early number with an abstract of the article in the "Register," to which our correspondent refers until he is able to procure an original and more particular account of the invention. We will feel obliged by his forwarding it so soon as he is able to procure it for us.—*Edits.*]

ON THE DRAGGING OF MARL FROM LAKES.

Gentlemen,—I shall be much obliged if some of your very able correspondents would take the trouble of communicating, through the medium of your Magazine, the best and most economical method of dragging marl from a lake, and laying it down on the margin, for the purpose of manuring the adjoining fields; and also of removing weeds, which now begin to form on the lake, and to be applied to the same purpose.—Engraved plans of the requisite boats or rafts and apparatus, with an estimate of all the expences of the boats, machinery, labour, &c. &c. and of the quantity and value of marl and weeds that can be daily put on shore, would be very desirable.—The lake varies in depth from three to eight feet, and is about twenty-five acres in extent. I fear steam apparatus would be too expensive.—It is said that marl is dragged to great advantage in some lakes in Dumfries and Galloway, on account of the method pursued; they would be very acceptable to,

Your most obedient,
A Subscriber.

Edinr. 1st June, 1826.

ON THE SPAWN OF FISH.

One day in March as I angled on a river, I captured some white trout. I ript them in order to find out the most successful bait from the contents of the stomach; I was a good deal astonished to find at such a season of the year, that it chiefly consisted of large Spawn apparently Salmons. I observed that, with the exception of a few dark spots, they were more pale and yellow in colour than I ever observed before. Curiosity led me to examine some of them, and found each contained the embryo of a minnow, the head, eyes, back-bone and ribs, and a small strip of blood down from the heart were distinctly visible. I suppose that it had lain in the sand as it was deposited by the parents in Autumn, and had been turned up by the large floods that happened to rise the river beyond its usual size, when they were swallowed by the watchful trout, when they appeared to be within a few days of being ready for bursting from their cells, and entering on a new state of existence.

As I see that some sketches of natural history find a place in your well-conducted columns, I have sent you this paper which, if you think worth a corner in your useful miscellany, it is at your service.—I am, Gentlemen,

Your Obedient servt.
John Whyte.

Easdale, 1st June, 1826.

MISCELLANIES.

Supposed New Metal, Taschium.—A description of a new metal, with an accompanying specimen, has been sent to the President of the Royal Society. The metal has received the name of Taschium, from the mine of Taschio, in which it was found. The specimen sent was said to be silver containing the new metal, the two metals having been separated by amalgamation, and the mercury afterwards driven off. On dissolving the button in pure nitric acid, it was stated that the Taschium would remain as a black powder. The Taschium was described as being combustible, with a bluish flame, a peculiar smell, and dissipation of the products; amalgamating with mercury, and in that way being separated from its ores; not soluble in any single acid, but soluble in nitro-muriatic acid. If previously boiled with potash, then soluble in muriatic acid, the solution being precipitated by water. Its solution giving, with prussiate of potash, a blue precipitate brighter even than that with solution of iron, but not precipitating with tincture of galls. The button was therefore dissolved in nitric acid, which left a blackish powder in small quantity, and also some grains of silicious sand. The powder was well washed, and then being heated on platina foil in the flame of a spirit lamp, did not burn or volatilize, but become of a deep red colour. Muriatic acid being added to another portion of the washed powder, and a gentle heat applied, dissolved by far the greater part of it, forming a red solution, which being evaporated till the excess of acid was driven off, and then tested, gave blue precipitate with prussiate of potash; black with tincture of galls; and reddish brown with ammonia. On evaporating to dryness, it left muriate of iron. Nitro-muriate acid being made to act on the minute portion of powder yet remaining, dissolved very nearly the whole of it, leaving a small trace of salica, and producing a solution similar to the former. Hence the Taschium in this button of silver was nothing else than iron; and from the presence of silicious sand it may be supposed to have been introduced into the button through the inaccuracy of the preparatory manipulations.—*New Monthly Mag.*

To free Glass and Earthenware from tainted Smells.—To free such glass vessels and other untensils that refuse to be removed by scouring with potash and sand, employ fresh burnt charcoal in powder, diffused in water. Rub them well with the wet charcoal, and then wipe them dry. If they still smell, repeat the operation.

Chemical Experiments. On the comparative advantages of Coke and Wood as Fuel.—Some trials have been made by M. Debret on the heating power of coke and wood, when consumed in stoves, at the Royal Academy of Music. Two similar stoves were heated, one by wood and the other by coke, and the temperature of the exterior taken at some distance from the fire. The temperature of the flues was at first 9° c., and the mean temperature, at the end of six hours, was, by the wood, 13° c., by the coke 16° c.; so that the increase by the wood was 4°, by the coke 7°. These effects were produced by seventy-three kilogrammes (163 pounds) of wood, worth three francs and a half, and twenty-four kilogrammes (53 pounds) of coke, worth one franc eighty cents.

During the progress of this experiment another stove had been heated for several hours with wood, and the temperature had not risen above 13°. The use of coke very quickly raised it to 15° or 16°. Hence it is concluded, and with reason, that coke is much preferable for these purposes to wood, but where the stove is small, the mixture of a little wood with the coke is recommended to facilitate the combustion.—*Bib. Univ.* xxv. 237.

To make Fire from Water.—Pour a little clean water into a glass tumbler, and put one or two pieces of phosphoret of lime into it: in a short time flashes of fire will dart from the water, and terminate in ringlets of smoke, which will ascend in regular succession.

To make ice in the midst of Summer.—Take eleven drachms of the muriate of soda. They should be recently chrystallized, and contain as much as possible of the water of crystallization without being damp. Reduce each of these salts separately to a fine powder, and then mix them gradually in a vessel made of fine tin plate, with five ounces of water. As the salts dissolve, a degree of cold will be produced, sufficient to bring the thermometer below the freezing point. If a little water in a test tube be immersed in this mixture, as the solution is going on, in about ten minutes it will be frozen. The vessel in which the mixture is made should be just large enough to contain it. Any thing, such as wire-bottles, jars containing conserves and fruits, lemonade for sick people, &c. immersed in this mixture, or moistened with it, and exposed to the action of a brisk current of air, may be rendered cold in the hottest day.

New Machine.—In a late sitting of the French Philomathic Society, M. Payen, who had recently arrived in Paris from London, made a very interesting communication with respect to a new machine, which seems destined to remedy the inconvenience of high-pressure engines, and to be to the steam-engine what the steam-engine was to the machinery of other descriptions, which it replaced with so much public advantage. The inventor is M. Brunel, who is at present employed in constructing a tunnel under the Thames. In conjunction with him, Messrs. Ternaux and Delessert have just taken out at Paris a *brevet d'importation.* The following is a description of the new force which the pursuits of industry have thus acquired: When a celebrated chemist, some time ago, succeeded in reducing to a liquid state several gases, until then considered as fixed, scientific men pointed out the advantage which might be derived from this discovery in the construction of new machines, the ammonia, and sixteen of sulphate, of action of which, although as powerful as that of high pressure steam-engines, should not be liable to the same inconveniences. It is this idea which M. Brunel has realized. In the apparatus contrived by this ingenious mechanic, the moving power is liquefied carbonic acid, at a temperature of 10 degrees, under a pressure of 30 atmospheres. This liquid gas is enclosed in two cylinders, placed at the two extremities of the apparatus, and communicating with each other. To destroy the equilibrium, it is sufficient to change the temperature of the liquid contained in one of the condensers. Now, the influence of heat on this liquefied gas is such, that, by raising it to 100 degrees, a pressure is obtained of 90 atmospheres,—an enormous pressure; which, having nothing to counterbalance it but that of the other condenser, sets the machine in motion with a force of 70 atmospheres. M. Brunel has already constructed a model; and is at present employed on a machine which will be of eight-horse power. His apparatus seems destined (as we have already observed) to replace Mr. Perkin's high-pressure engines. The latter are almost useless in practice, in consequence of the difficulty of finding metals capable of sustaining, without injury, the enormous heat that is necessary. The metal, raised to a white heat, becomes so exceedingly softened, that hitherto it has been impossible to use it for several successive hours without the production of cracks or fissures. It is true that Mr. Perkins hopes to discover a means of remedying this evil; but his efforts have not yet succeeded. The great advantage of M. Brunel's machine consists in its being unnecessary to raise the temperature of the condenser above that of boiling water, in order to produce the considerable pressure of 60 atmospheres.—*Le Globe.*

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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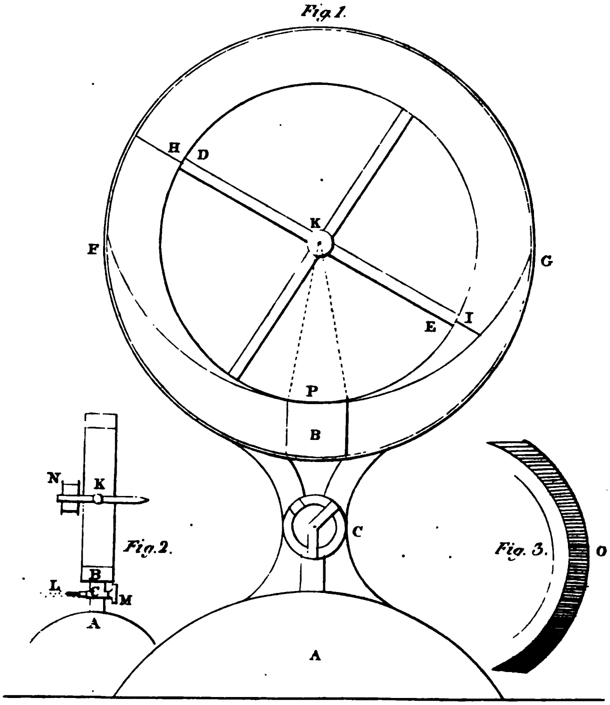
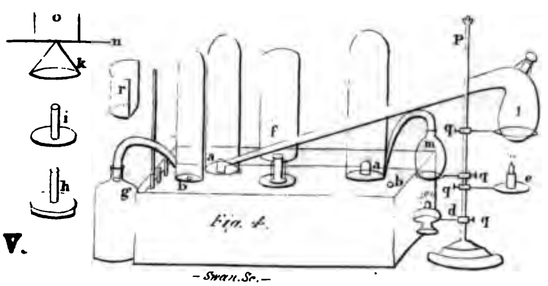
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

> "To bring forth knowledge agreeably, as well as usefully, is very difficult for those who have attained it in the secluded walks of study and speculation, and is an art seldom found but in men who have likewise acquired some knowledge of the world."—*Henry Mackenzie.*

No. CXXX. *Saturday*, 17*th June*, 1826. Price 3*d*.

ROTATORY STEAM ENGINE, BY E. C.; PNEUMATIC TROUGH, BY JOHN DEUCHAR, Esq.





Vol. V.

A NEW ROTATORY STEAM ENGINE.—INVENTED BY MR. E—— C——.

[Mr. Deuchar has favoured us with the following communication from his friend, Mr. E. C., regarding the above engine.]

TO THE EDITORS OF THE GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—In the last number of the Glasgow Mechanics' Magazine, I observe some hints made regarding a very simple Rotatory Steam Engine, invented by Mr. Eve of America; of this I have seen no account, but shall be glad to have that opportunity so soon as you get the number of the "Register," in which you say it is expected to make its appearance. In the mean time, I send you a drawing of one I made about 18 months ago, intending then to have constructed a working model of it, which I have not yet had time to do; but you will, in a few weeks, have an opportunity of seeing it in action at the workshop of Mr. William Fairservice, optician, No. 88, Gallowgate, who has been employed to make the model for me; Mr. Deuchar has also given Mr. Fairservice instructions to make one which will operate either with Steam or compressed air.

Description of the Rotatory Steam Engine.

Let A, (fig. 1.) be a part of the boiler which is to produce the Steam: or there may be attached at A, a pipe from the steam boiler at a distance; then the steam is admitted through a three way cock at C, into the interior space between the two circles on the sketch, in which there is placed a stop at B, and the eccentric semicircle F B G which is pierced full of holes to allow the steam to pass through into Q P; H is a sliding valve exactly fitted to P Q, which slides into D, and is forced in by pressing along F B on the one side, and G B when turning in the other direction, which enables the wheel to get past B; I is another of these valves which slides into E, and is shewn partly forced in; both D and E contain springs which force H and I out again, as soon as they are freed from the pressure of F B G. As the figure is drawn, the steam entering through B, and the holes in B, G, will act on the sliding valve H, till it arrive at the point F, when it will be shut out from the steam by I, which will have arrived at G; and at the same time, by H beginning to be forced into D, a communication will be opened between the other side of the valve, and the condenser, or the external air, if it be used as a high pressure engine; and it will thus continue a rotatory motion, by the steam acting always upon one valve, until it be shut out by the other. This motion can be instantly reversed by turning the cock C, in the opposite direction, which might be very convenient for steam-boats, drawing up weights from pits, &c.

This engine will also make a convenient force pump, to be turned by a handle, &c. and the pipe A will then require to be supplied with water.

Fig. 2. gives a side view of the former figure; M is the stop cock at C, for allowing the entrance of the steam at either side of the wheel; this stop-cock has an opening through it at the side L, which,

the steam is entering in the
ection, allows it to escape in
ier after it has performed its
ion, as is seen at L. N is a
which turns with the steam-
D E, upon the axis K, and
may be put a leather belt to
achinery.

Fig. 3. shews the side of the part holding the moveable wheel D E.—
I am, Gentlemen,
Yours, &c.
E. C.

Glasgow, 12th June, 1826.

THE GEOLOGICAL DELUGE,

terpreted by Baron Cuvier, and Professor Buckland, inconsistent with the Testimony of Moses, and the Phenomena of Nature.

w era may be said to have
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nor irreligion under any
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h delight. In turning over
ges of the memoirs of the
rian Natural History Society,
we have abundant opportunities to admire the deep research, the accurate details, and their happy applications, as developed in the numerous papers of Dr. Fleming,—but, at present, we mean more particularly to direct our readers to his very excellent Essay on "The Geological Deluge," published in the Edinburgh Philosophical Journal (April 1826), in which he proves that the doctrines laid down by Baron Cuvier and Professor Buckland, are inconsistent with the testimony of Moses, and the phenomena of nature.

In this paper, after briefly noticing the views of the earlier theorists, who employed more the creations of the imagination, than the doctrines of science, or the phenomena of nature, to support their respective tenets, he proceeds to inform us, that in reference to the important subject he has under review, there are two questions occur; "1. Does the character of any of the members of the modern strata, demonstrate the occurrence of an universal flood, as exclusively the agent in their formation?" and, "2. Does the character of the Geological deluge, as supposed to be indicated by the phenomena of nature, agree with the character of the deluge of Noah, given by Moses?" In pursuing the consideration of these two questions, Mr. Fleming reverses the order in which they have been put, holding that if the second can be answered in the negative, then the first is left to be examined entirely by physical laws, and without prejudice. "It is my object," says he, "in the present communication, to point out the infidel side of the question, viz. the one where error prevails. Nature, misinterpreted, may amuse the cosmogonist, but never can befriend the Christian. That which is true in science can alone give useful support to Revelation; and that which is true in science never can be found opposed to its interests."

He then proceeds to overturn a number of Baron Cuvier's doctrines, regarding the historical parts of Moses' writings, and he, in a forcible and satisfactory manner, shews, that Cuvier has twisted and misconstrued the divine record; for Moses states, 1. That all the living remnant of the world were, during the deluge, contained in the Ark: 2. That there were male and female of every animal that had previously existed: 3. That the waters covered the highest hills, and that those were all left clear again after the flood: 4. That the deluge was gradual: 5. That the face of nature does not appear to have been changed, excavated, torn down, &c., as Professor Buckland attempts to prove; Moses hints at no such thing, but the reverse, in saying, "The dove plucked an olive leaf," for it proves the soil was not disturbed.

Mr. Fleming, in the second part of his paper, shews that the discoveries in science, and the phenomena and face of nature do not present
any thing, in the slightest degr
contradiction with the histo
Moses.

In disposing of this part of hi
ject, he directs our attention
To the excavation of vallies
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—and proves from the other
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The nature of Mud caves;
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and proves his views by nun
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of native animals in our gravel
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After giving very satisfacto
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land, Dr. Fleming conclud
the following words: "P
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from physical science, may giv
their opinion, that the Dei
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created new soil, re-create
plants, and re-created a part
species of animals which had
destroyed. Is not the sile
Moses fatal to the conje
Would he have failed to

e sacred volume, this second ificent display of creative r.

From the preceding statements, l warranted to conclude, that occurrence of the geological e, in its effects, such as the ates of the diluvian hypothesis ibe, is like similar inventions ir predecessors, Burnet, Wood- and Whiston, disproved by uths of Geology, the truths of gy, the truths of Phytaology; and contradicted by the authority of Revelation."

We now dismiss the subject of Dr. Fleming's illustrative proofs of the mutual agreement, that subsists between the operations of nature and the records of Divine inspiration;—but we do so, with an earnest wish, that our readers would peruse these important papers at large, as they will be found in the volumes of Professor Jameson's Journal.

I. D.

THE STEAM BOAT RAINBOW.

ERY Scotsman now-a-days s a trip to the lakes and islands west, for who is there boast- aledonia for his birth-place, ould not wish to descend into ave of Rob Roy—to feast on istoric luxuriance of Icolm- or to admire with geological siasm the Basaltic columns of , and the sparcaves of Sky!

t many of our readers have not o fulfil the wishes which they —and to them some of our fortunate correspondents may great service in communicat- y of those curious or singular rances which sometimes pre- hemselves during steam boat sions. It is a desire of this which leads us at present to l a phenomenon which attract- e attention of a Loch Lomond on Thursday last week. The had been very warm, almost erably so, for Phebus had ly for a moment closed his eyes the "Lady of the Lake," dur- e whole of her voyage, whilst ot to be outdone by the bright n her knowledge of the sour- om which the heat he gloried *as to be procured,* plied her resplendant engine with a very Vulcan's energy, till even the philosophic inmates were forced to acknowledge her superior power, as they melted away before its influence. Even the most disagreeable combinations, however, have their attendant alleviating circumstances; and so it happened to the party on board; for the "Lady of the Lake" in her exertions to outstrip bright Sol, threw the water of the Loch in parabolic curves around her sides, which he, piercing with the dazling radiance of his powerful eye, produced the most resplendant arch of prismatic colours which the fancy could picture. It was to this appearance that the attention of the passengers was directed. The fact was first pointed out by a scientific gentleman whom we had seen, an hour before, snatch from the inmost recess of Rob Roy's cave a mass of Micacious Schistus, and to him we were indebted for the only remarks that seemed to be expressed on the subject. He bade us observe, that when the rays of the sun shone in a line with either edge of the steam-boat, that then the prismatic colours (or Rainbow) formed a right angle with the side of the boat; when the sun was in a line with the deck, or situated towards the other side of the boat, then there were no colours seen; and when the rays fell obliquely upon the same side, then according to the quantity of that obliquity, the Rainbow-colours were more or less bent, as it were under the wheel of the steam-boat. We found, upon catching the proper relative situations of the sun and boat, that the colours appeared in the direction we were as above led to expect.

We overheard the same gentleman explaining to the captain how he might cook the whole of the dishes for dinner expeditiously and economically on board; so as to render the whole more comfortable for the passengers than could occur, when they were supplied from Dumbarton. At another time, he enforced the propriety of improving the facilities for examining Rob's rocky dwelling,—the interest the trip would acquire from a half-hour's ramble being allowed on one
islands, or some romantic
the bank,—the great attractio
a floating bath, attached to t
would have during an insu
warm day like the one they
perienced; and he then proce
expatiate upon the barbaro
quity of the mode adopted f
ing the passengers (after t
of Robinson Crusoe and h
Friday) in a hollowed mass o
from the coaches to the
boat by the aid of six lo
poons! that even the fish, af
at the savage rudeness of th
dart through the silver stre
hide themselves in the dist
weed.

But we had now arrived
bottom of the lake, where
to leave the steam-boat,
captain to digest the advices
and we again jumped into t
poon-boat and proceeded on
turn to Glasgow.

PHYSICO-CHEMICAL RESEARCHES ON CHARCOA

By M. Cheuvreusse, Professor of Chemistry at the Royal Scho
Artillery and Engineering.

Men of science, both ancient and modern, have published a great number of works on the properties of charcoal, and notwithstanding the extent of their researches, the most of their labours are incomplete.

In considering charcoal with respect to electricity, they have remarked that some charcoals give a free passage to that fluid, while others refuse to transmit it; but they have not analyzed the circumstances of this phenomenon.

On the other hand, charcoals have been regarded in general as b
ductors of caloric; neverthel
perience shews that there is
difference between them in
spect.

If the labours undertaken
hygrometric properties of c
are examined, it will be se
they have not been pursued.

The combustibility of c
has been studied; but the
presented leave much to be

The state of imperfection i
our knowledge of charcoal is

sent, has led me to submit the
rties of this combustible body
ew examination.
ill make it be seen that char-
ay be found in two states re-
to its faculty of conducting
city ; then I will endeavour to
that the same takes place with
to its power of conducting
, and that the same sort
conducts electricity likewise
cts caloric.
ally, in treating of the com-
ility, I will make it evident,
charcoal from the same piece
od will be found more or less
stible, according to its state
bonization.

Of the Carbonization.

wo pieces of wood, produced
same branch, be taken, and
tted to distillation in a retort
ne-ware or porcelain, until
ore vapours pass off, two
of charcoal will be produced
same nature, and in the same
f carbonization.
after this first carbonization,
the pieces of charcoal be re-
on the retort, and be heated
ness, from these two opera-
wo pieces of charcoal will be
ed, which will possess very
nt properties.
sorts of light and heavy wood
could be procured, both na-
nd foreign, submitted to these
istillations, have given char-
which presented the same dif-
es.
rcoals from animal substances,
ed by a first distillation,
not be made to change their
but by a violent degree of

change the property of vege-
charcoal, it was sufficient to
the fire red; the method of applying the heat is indifferent. Whether the operation is performed in close vessels, or in the open air, the result is the same. If it is effected by ignition the mode of extinction is equally indifferent.

In general, charcoal may be found in two opposite states, resulting from the intensity of the heat which has been applied to them during their preparation.

In the course of this memoir, I will distinguish the two sorts of charcoal into charcoal in the first state, and charcoal in the second state of carbonization.

Of the Conductibility for Electricity.

It has been long since remarked, that among charcoals some had the property of transmitting the electric fluid, but the study of the circumstances which accompanied this faculty has been neglected.

In the experiments which I am going to recite, all the charcoals in their first state of carbonization, and which are newly prepared or dried, do not ever conduct electricity, and they do not become conductors but when they have undergone the action of a strong fire.

A fact which it is important to recite is, that the charcoal which is not a conductor does not develope electricity by its contact with zinc or iron, and when it is a conductor it produces electricity by this contact.

The conducting property of a charcoal for electricity may therefore be varified by the contact of zinc or of iron; and this simple method is even preferable to others, since, if the non-conducting charcoals are humid, they transmit electricity; wherefore the application of one of these two metals, and principally of zinc, will be the method which we will use to ascertain the state of conductibility of a charcoal for electricity.

If charcoal which is to be examined is in a state of powder, it may be made into a paste with gum water, and a tablet may be obtained which may be tried with facility. The only precaution to be taken is, not to add more of the mucilage than is necessary for making the paste.

To a charcoal in the first state of carbonization, the faculty of conducting the electric fluid at one of its points may be given, by making this point red hot. This experiment is easily performed by heating a small cylinder of charcoal at the flame of a candle; when it becomes red it is to be dipped in water. If it is then tried, it will be perceived to have become a conductor of electricity.

The best conducting charcoals which I have as yet been able to meet, are those which have escaped combustion during the reduction of iron ore in the high furnace, and which are drawn out along with the slag.

From these results we may range all these charcoals into two great classes,—charcoals that are conductors of electricity, and charcoals which are non-conductors.

Of the Conductibility for Caloric.

Nothing has yet been published on the conductibility of charcoal for caloric; and this combustible body having been known to present the greatest resistance to this fluid, has been named a *bad conductor*. This error has arisen from its having been believed that charcoal only existed in one state; but the experiments which follow prove that some charcoals refuse to conduct caloric, while others transmit it with sufficient facility; and it is extremely remarkable, that the charcoals which are conductors of electricity are also equally conductors of caloric.

If a piece of charcoal be chosen without cracks, and without knots, of a cylindrical form, about three lines in diameter, in the first state of carbonization, and that one of its extremities be exposed to the flame of a candle, the heated part will enter into combustion, and the propagation of the heat will not be sensibly extended beyond the part immersed in the flame.

If the same operation is repeated with a cylinder of charcoal, taken from the same wood, in the second state, and consequently a conductor of electricity, the effects which will be observed will be different: the caloric will be immediately transmitted from one end of it to the other, and the sensation of heat will become so great that fingers of any delicacy would be unable to hold the charcoal in the experiment. The extremity placed in the flame will moreover be observed to grow red, and not to burn in so decided a manner as in the first case.

The theory had before pointed out that the effects observed should thus take place: in the first experiment the accumulation of the caloric increased the ignition; and in the second its transmission opposed the inflammation.

These simple experiments may shew the difference of conductibility between the two sorts of charcoal; but as they do not seem sufficient for naturalists accustomed to the most scrupulous exactness in all their researches, I have made use of the little apparatus which I am going to describe.

To make this experiment, a vessel

of earthen-ware, or of wood, may be used, the sides of which are of equal thickness. These sides should be pierced with two holes, from 0.015 metre to 0.020 in diameter, for the reception of two charcoals of the same dimensions, the length of which should be exactly equal, and which should only differ in their state of carbonization.

The external extremity of each of these charcoals should be hollowed, to receive the bulb of a thermometer, which should be kept in contact with it, and should be supported in an horizontal position. The vessel should then be filled with mercury, the temperature of which should be near ebullition.

The result of this disposition must be, that the two charcoals would be in the same circumstances, since their interior extremities are exposed to the same source of caloric.

In one of the experiments made with this apparatus, on employing two charcoals of poplar, one in the first state of carbonization, and the other in the second, and on using two thermometers marking 20°, (Reaumur,) before the operation, I observed that the thermometer, applied to the charcoal in the second state, rose rapidly from the instant that the vessel was filled with mercury, whilst the other was stationary, and that a few instants afterwards it indicated 38°, that of the charcoal in the first state of carbonization being still at 23°, that is to say 15° below the first.

The thermometer, lodged on the charcoal in the second state of carbonization, arrived rapidly to its *maximum* of 40°, while the other, after a long interval of time, did not rise beyond 25°.

This last experiment leaves no doubt respecting the difference of conductibility of the two charcoals for caloric; and it proves besides, that the charcoals which are conductors of electricity are equally conductors of caloric.

We have, therefore, a sure method of knowing, *a priori*, if a charcoal is fit to be employed as a non-conducting body in a physical apparatus.

Of the Density.

It is known that the specific gravity of charcoals in general arises according to the density of the wood from which they are made; but in the course of my experiments I have always remarked, that those of equal weight in the first state of carbonization had constantly a greater bulk than those in the second state, that is to say, which had been prepared in the contrary circumstances.

To verify this first perception, I examined the density of charcoals of black alder in their two states. To effect this design, I weighed equal volumes of the charcoals, divided to the same thickness, and in the two states of carbonization already recited, and found that the density of the charcoal of black alder, in the first state of carbonization, is to that of the charcoal of the same wood in the second state, as 4 is to 3.

I then took charcoals of the extreme limits of density afforded by those in my possession, that is to say, poplar and guiacum; the woods of which had for their respective densities 0.3042 and 1.3132 but instead of weighing them after I had pulverized them, as in the first case, I took their weight in air and in water, in determining the quantity that they absorbed of the latter, and I then obtained the following results :—

Charcoal of Poplar,—	1st carbonization	0.12372
	2d carbonization	0.18743
Charcoal of Guiacum,—	1st carbonization	0.68718
	2d carbonization	0.84829

From this table the consequence may be drawn, that of light wood, that of poplar for example, the charcoal in the first state of carbonization has a density two-thirds of that of charcoal in the second state of carbonization ; whilst for the more compact woods, such as that of guiacum, the density of the charcoal in the first state is a little above three-fourths of that of the charcoal in the second state.

These experiments prove, moreover, that charcoals prepared from the same wood may be, with regard to their density, distinguished into two classes, and that the most dense charcoals are those which are conductors of electricity and of caloric.—*An. de. Chime.*

MODE OF PRESERVING LIME-JUICE.

(Communicated to the Society of Arts by CAPTAIN T. M. BAGNOLD.)

IT is well known that the juice of lemons, or of limes, expressed from the fruit, will, in a short time, especially if kept warm, become mouldy, and unfit for use as an article of food ; and that the final result of this spontaneous change, is the destruction of the acid itself. The acid may, indeed, be separated from the other matters with which it is naturally fixed, but in so doing, all the odour and flavour of the native juice are also destroyed ; for pure crystallized citric acid is wholly inodorous, and, to the taste, simply acid.

The effect of pure *citric acid*, in preventing or mitigating the severity of sea-scurvy, is greatly inferior to the recent juice ; and in many of our circum-navigations, lemon or lime-juice, mixed with a small proportion of rum, about one-tenth, has been found to keep for a considerable time in tropical countries, and to be very efficacious in preserving the health of the crews, In some cases, however, this addition *of spirit is by no* means desirable.

In April, 1824, Captain Bagnold produced to the Committee a specimen of lime-juice, which had been prepared in Jamaica in the preceding September, according to his directions. The juice having been expressed from the fruit, was strained and put into quart bottles ; these having been carefully corked, were put into a pan of cold water, which was then by degrees raised to the boiling point. At that temperature it was kept for half an hour, and was then allowed to cool down to the temperature of the air. The process, therefore, was in substance, only the same as that which has been long practised in this country for preserving green gooseberries, and other fruits, for domestic use. A bottle being opened by the Committee, the juice was in the state of a whitish, turbid liquor, with the acidity, and much of the flavour of the lime ; nor did it appear to have undergone any alteration.

In March, 1825, some of the same juice which had been examined the year before, and which had since only been again heated and carefully bottled, was laid before the Committee. It was still in good condition, retaining much of the flavour of the recent juice.

Hence, it appears, that by the application of the above process, the addition of rum, or other spirit, to lime or lemon-juice, may be avoided, without rendering it at all more liable to spontaneous alteration.—(*Trans. Soc. Arts.* Vol. XLIII.)

SCIENTIFIC CORRESPONDENCE.

TO THE COMMITTEE OF ANDERSON'S MECHANICS' CLASS.

GENTLEMEN,—Permit me, through the medium of this very useful work, to call your attention to what I conceive to be an object of the greatest importance to the majority of the six hundred students who usually attend your class, and whose primary object it is to acquire useful information connected with the Arts and Sciences.

Your Library appears to contain a very excellent selection of scientific books, which are calculated to afford both instruction and amusement, but as you do not change the books to the readers, oftener than once a-week, many of them are from their greater application to reading, in want of other books long before the library evening arrives.

There are also a great many useful periodicals, which either are, or ought to be taken in for the use of the students, but from their being a certain number of parts or numbers bound in one vol., they are seldom, if ever, given out to read till so bound, and the class is thus prevented from seeing what is *new*, till it has become *old*.

To remedy both of these inconveniences, I would seriously recommend, that the Library should be open *as a Reading Room*, at least twice *a-week, from 7 to 9* o'clock in the evening, when for a small quarterly subscription, or payment of a penny or so each visit, the students should have the privilege of seeing such books as they wished to see, and perusing the periodicals as they appeared. Regulations could easily be adopted, which would secure the good usage of the books perused, by each person writing his name, No. and the title of the book wanted, upon a card, which would be retained by the person in attendance, and the students would thus, before leaving the room, return the book to the atendant and receive back his card. This would prevent any book or periodical from being taken out of the room without the attendant's knowledge.

Such, Gentlemen, is the plan I propose, and I trust it will meet with your approbation. There is every facility for its being carried into execution. The place adjoining your library-room, is well seated, and well lighted, and no difficulty would be found in procuring a person to be in attendance at these hours. The plan is certainly calculated to promote the great work o. improvement, and from the anxiety you have hitherto displayed in promoting this work, I calculate with certainty on your adoption of this plan, if it shall appear to you as useful as it does to me. I might enlarge upon the benefits which would morally, as well as mentally result from it, but as you can perceive these at once, I consider it useless to say more regarding them. —I am, GENTLEMEN,

Your obedt. servt.

A MEMBER *of Anderson's Institution.*

CHEAP METHOD FOR DRYING CORN·

GENTLEMEN.—I have long thought that there might be some better and cheaper plan constructed for drying corn (say oats) previous to their being ground into meal, the present mode being both tedious and expensive.

I should, therefore, propose to dry the oats for mealing in a large cast Iron Pan and this to be heated by steam; this pan might be from 6 to 8 feet diameter, with a smooth, flat bottom, and 6 or 8 inches deep; this is for holding the corn, and under this vessel is another of cast iron or of wood, 2 or 3 inches deep, and made steam tight; the steam is introduced betwixt these vessels which will raise such a heat in the upper one, as will be fully sufficient for the purpose proposed and the panful of corn would be dried in a very short time; when this is done, the process can be repeated as often as necessary.

Where corn mills are drove by steam engines, a little steam can be brought from the boiler by a small pipe, which would answer the purpose but when water is applied as the moving power, a small boiler could be erected for the purpose. The corn could be dried much faster in this way than any mill could grind it, and without the least chance of burning it or giving it any bad taste by over heating.—If this should meet the eye of any of those engaged in this trade, perhaps they may improve upon it; at any rate, by inserting it in your useful Magazine you will oblige,

M. P.

Dunfermline, 5th June, 1826.

TO THE EDITORS OF THE GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—The importance of accuracy in Logarithm Tables is well known. In the fourth edition of "Hutton's Mathematical Tables," the one which I use, there is an error in the table of the Logarithms of Numbers, which, if not recognized by the calculator, may occasion serious mistakes, as it runs through the Logarithms of no less than 105 numbers, namely from 45290 to 45394. The logarithm of 45290 is printed 4560023 instead of 6560023, and as the first three figures are understood to belong to the Logarithms of the subsequent 104 numbers; it is of the greatest importance that those who have this edition of the work should rectify the error. In the Introduction to the same work, p. 12., there is a table of the length of the sides of polygons inscribed in a circle in the last line of which for $-\sqrt{2}$ read $+\sqrt{2}$, and in the third line from the bottom of the page, the expression for the side of the polygon of 32 sides should be printed as in the last line of the table so corrected.—I am, GENTLEMEN,

Yours, &c.

R. WALLACE, Jun.

33, George's Square, June 12th, 1826.

MISCELLANIES.

1. *Fine Sand for Flint Glass found at Alloa.*—Every new mode, by means of which the mineral productions of our country, may be exposed to notice, and applied to useful purposes in the arts, cannot fail to be received by our readers with the greatest pleasure. It has been seriously lamented, that in the manufacture of that useful compound, Glass, which glistens in every corner of our dwellings, the sand which was to be employed, bore a high price on account of the distance from which it had to be brought; this inconvenience, in so far as regards the west country, has been removed by means of a discovery of Mr. Robert Bald, civil engineer in Edinburgh, that a fine sand, even superior to that from Lynn Regis, at present used in England and Scotland, is to be got in abundance at Alloa, and this sand has already been advantageously employed in the manufacture of Flint Glass at the Alloa glass-works. It occurs in the lower strata of the coal-field in the neighbourhood, in the form of a whitish sandstone, which has been long employed in building; the sand of Lynn Regis, when received in Scotland, cost twenty shillings per ton, whereas that discovered by Mr. Bald, can be delivered at Alloa for one shilling per ton. Mr. Marshall has manufactured some glass with this sand, and it is perfectly colourless, and equal to the best Flint Glass.

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2. *A New Acid.*—Mr. Faraday has discovered a new acid, consisting of

Sulphuric acid,	8.0.
Carbone,	12.0.
Hydrogen,	.8.

he has given it the name of the Sulpho-Naphthalic acid. It is formed by the action of the sulphuric acid upon naphthaline; its salts are soluble in water, and in alcohol. This acid crystalizes regularly, diliqueces in a cold air, fuses at 212°, and chars and burns with an intense flame at a higher temperature.

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3. *Luminous Phenomenon observed between Paisley and Glasgow.*—It gives us much pleasure to observe, in Dr. Brewster's journal, that Mr. Murray has been gratified by the sight of a luminous globe, while he was going from Paisley to Glasgow. It was of an elliptical form, and somewhat stationary in its situation; after some time, it discharged sparks and this was subsequently repeated; from the re-action of the earth, Mr. Murray says it moved from north to south, maintaining the direction of a horizontal plane. The sparks were star-like, bright, silvery, and void of any chromatic tint. This Meteor, which was interesting and beautiful, Mr. Murray thinks was wholly dependant on an Electro-Magnetic principle; the night had been wet and tempestuous, and the whole day had discovered the clouds of the distant sky of a horizontal parallelism. It is a pity Mr. Murray has not published the exact day on which this Meteor appeared, in case it should have escaped the notice of the philosophers of the west, who might think the "14th instant" of a Quarterly Journal not so precise as they could wish.

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4. *Luminous Meteor.*—On the 2d of January 1825, about 5 o'clock in the evening, M. Antonio Brucalassi, observed between S. Giovanni and Montevarchi, a singular electrical phenomenon. About an hundred paces off, and at the height of ten fathoms or less from the ground appeared, on a sudden, a luminous meteor of the form of a truncated cone. This meteor appeared to be formed by a globe of fire situated in its fore part, which was the narrower, and which, by its rapid motion, left behind a track of light, which gave it the appearance of a cone. This light became gradually less intense towards the base and seemed to be split into rays issuing from the opposite extremity. The whole of the surface was illuminated, and sent out brilliant sparks, like those of electricity, although in the effect shewn, they rather resembled the appearance of iron filings when thrown upon flame. The whole length of the meteor appeared to be about two fathoms, and the diameter of its base half a fathom. It proceeded from East to West, rather inclining, from the horizontal position, towards the earth; it moved with great

rapidity, in 5 seconds going over a space of about 350 paces;—and as it moved it shed a most brilliant light upon a considerable extent of land which it illuminated as in full day light. Its emanations were lost in the air; it did not produce any explosive or hissing noise, and it left no smell behind it; it occurred in a calm, cold night, during a clear sky, and a great number of shooting stars were observed before and after the appearance of this phenomenon. Professor Jameson extracts the account of which we have given a sketch, from "Antalogia for Feb. 1825." From the apparently accurate description given of this meteor, it appears to us that it was the result of the formation of a shower of meteoric stones, upon the principle laid down by Mr. Deuchar in his lectures on that subject in the Mechanics' Institution, and of which we mean to give a description in another part of our Magazine; the great distance at which it appeared would prevent the explosion being heard by M. Antonio Brucalassi; the operation of innumerable separately attracting neuclei might prevent the atoms uniting into large masses, and the retention of a considerable quantity of the electricity discharged through them might cause the small meteoralites to repel each other in the conical form above described. The rapid motion of the cone would press it closer to the air it passed through, and would cause the evolution of the sparks; and the brilliancy would be greatest where there was the readiest contact with the atmosphere. The direction and rapidity of motion in the meteor, arise from the cooperation of so many obscure circumstances that the philosopher placed, as he is, at so considerable a distance, can never be able to calculate their quantity, or completely to analyse the causes which effect their production; theory, therefore, must be called in, divested of every title to demonstration; but such theoretic speculations, when they are founded upon facts resulting from similar processes in other departments of the phenomena of nature, are not only justifiable, but highly beneficial, because they shew us how the most singular appearances in nature may be traced to causes remarkably simple and quite consistent with that harmony and wisdom which pervade all things.

5. *Blue and Green Colours.*—M. Bauhart has discovered an easy process for obtaining a beautiful blue from the leaves of the herb called Althæa Rosea. The flower furnishes a very beautiful green, which may be used for dyeing wool, wood, horn, &c. The blue is said not to be inferior to indigo.—*Professor Jameson's Journal.*

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6. *Fine Black Paint.*—Signior Bizio considers the black matter of the ink of the cuttle-fish, as a new substance. It has been found to succeed well as a pigment, in some respects better than China ink. It is obtained by digesting the ink with nitric acid, very much diluted until it became yellowish, then washing it well, and separating it by a filter; it is then to be frequently boiled in water; one of the washings to be a little alkalized, and finally with distilled water.—*Dublin Phil. Journ.* 1825.

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7. *A new mode of condensing the Wood to be used for Furniture.*—Mr. J. Astlie has taken out a patent for a method by means of which he can condense wood, and make it quite close in the grain so that it may resist moisture. This invention renders the wood very fit for all kinds of furniture, and must be highly prized by the cabinet-maker, as it will prevent their finer work from casting, or being at all affected by a damp atmosphere. Dr. Brewster gives the following brief account of Mr. Astlie's method for producing the effect: it consists in cutting the timber into planks with parallel surfaces. These planks are passed between parallel iron or steel rollers with highly polished surfaces, which condense the wood by their pressure. The pressure thus applied must be at first small, and afterwards gradually increased, otherwise the wood will be crushed or split. The best way of applying the principle is to place several pairs of rollers behind each other, the distance between each pair progressively diminishing. The sap or moisture will thus be forced out of the pores of the wood, and the ends and sides of the plank, and it will thus be rendered stronger, heavier, and harder, and less pervious to moisture than in its natural state. When used in furniture it is less liable to be scratched, and does not

shrink. Oak and mahogany admit of much more compression than fir or other slight woods, and Honduras mahogany may be rendered as hard and heavy as the best Spanish. If one of the rollers is sufficiently bright, a finished polish may be kept upon the surface. This plan is particularly useful in ship carpentry, for making wooden bolts, trenails, and dowels of a compact quality.

8. *Whirlwind in the neighbourhood of Glasgow.*—Our friend, Mr. L. J., has just described to us the effects of a slight whirlwind which he witnessed in coming from Kilmarnock on Friday last week, at about 10 miles from Glasgow; it occurred in a field off the road; the most moveable materials were carried up in a spiral form, and exhibited a very interesting slender cone; the passengers in the coach were not sensible of the atmospheric commotion which operated in whirling round, and elevating the materials into the conical appearance which they witnessed in the adjoining field.

9.—*Cork cutting Machine.*—One of very simple construction is used in France, for making bottle corks; by means of this machine, with the simple attendance of a child, 500 corks are produced in an hour. The sheets of cork are cut into strips by a distinct machine, and they are rounded by a second process.—*Register.*

10. *Fire and Water Proof Cement.*—Pour a pint of vinegar into a pint of milk; when the latter has fully coagulated, clear it off the lumps, and let it settle, then mix the whole well together; now sift into the liquid quick lime, till upon stirring the whole we obtain a thick paste. This cement will permanently unite marble, earthenware, china, &c.—*French paper.*

11. *To preserve Potatoes.*—Mr. Roberts has taken out a patent for the following method for keeping potatoes, carrots, turnips, and other vegetables, in the warmest climates for a considerable time:—"Take the potatoes, or other vegetables when thoroughly ripe, and before they have grown in the spring, cut out with a knife the germs or eyes, or destroy them. The more they are kept from the air, the finer they will be."

12. *Magnetising power of light.*—Mrs. Somerville has detailed to the Royal Society, a number of beautiful experiments, from which she infers that the more refrangible rays of light have the property of imparting magnetism.

13. *Economy in Glass making.*—Muriate of soda, and sulphate of soda may be employed with advantage in the manufacture of Glass. A very fine gloss is made from

Decrepitated Muriate of Soda,	100 parts.
Slaked Lime,	100 "
Sand,	140 "
Clippings of Glass of the same quality, from	50 to 200 "

Sulphate of soda may be likewise used, and with economy and satisfaction; it produces a gloss of a fine quality; the composition is,

Dry Sulphate of Soda,	100.
Slaked lime,	12.
Powdered Charcoal,	19.
Sand,	225.
Broken Glass, from	50 to 200.

These proportions give a rich glass, which may be employed with advantage in glass houses, where a fine quality is wanted. The following is a second way of using this last salt:—

Dry Sulphate of Soda,	100.
Slaked lime,	266.
Sand,	500.
Broken Glass, from	59 to 200.

According to this process, it is obviously easy to operate in a regular manner, and to avoid expensive trials in the manufacture.—*Annales de l' Industrie Nasionale.*

15. *New method of preparing Writing Quills.*—M. Schloz renders quills more durable, and even superior to Hamburgh ones, by the following process:—He fills a kettle one fourth full of water, and suspends in it the barrel ends of the feathers perpendicularly, so that their extremities only may touch the surface of the water; he then covers the kettle with a lid adjusted to the feathers and kettle, boils the water, and keeps the

barrels in the vapour for four hours. He thus frees them of their fatty parts, and makes them soft and transparent. Next day, after having scraped them, and rubbed them with a bit of cloth, he gives them a moderate heat. By the second day they are quite hard and transparent, without splitting too easily.

16. *Population of Great Britain.*—In Great Britain, the number of individuals in a state to bear arms, from the age of 15 to 60, is 2744847. The number of marriages is about 28030 yearly, and it has been remarked that in 63 of these unions there were only three which had no issue. The number of deaths is about 332708 yearly, which makes nearly 25592 monthly, 6398 weekly, 914 daily, and 40 hourly. The deaths among the women are in proportion to those of the men, as 50 to 54. The married women live longer than those who continue in celibacy. In the country, the mean term of the number of children produced by each marriage is 4; in towns the proportion is 7 for every two marriages. The number of married women is to the general number of individuals of the sex, as 1 to 3, and the number of married men, to that of all the individuals of the male sex, as 3 to 5. The number of widows is to that of widowers, as 3 to 1; but the number of widows who marry again, is to that of widowers in the same case, as 7 to 4. The individuals who inhabit elevated situations live longer than those who reside in less elevated places. The half of the individuals die before attaining the age of 17 years. The number of twins is to that of ordinary births as 1 to 65. According to calculations founded upon the bills of mortality, one individual only in 3126 attains the age of 100 years. The number of births of the male sex is to that of the female sex as 96 to 95.—*Jameson's Journal.*

17. *Panto Chronometer.*—This useful little instrument is a combination of the compass, sun dial, and universal time dial, and is a beautiful and interesting pocket companion. They may be seen at Mr. Davies' in the Trongate; where some of them may be got which also contain a thermometer and hygrometer; they cost from 8*s.* 6*d.* to 3 Guineas each.

18. *Prize Questions of the Parisian Society of Pharmacy for* 1826.—This society offer a medal of 1000 francs to the person who shall solve all the following questions completely; and a medal of 500 francs if they are not entirely solved, to the person who solves most of them. Persons of all nations may compete for the Prize.

1st. To determine the essential phenomena which accompany the transformation of organic substances into acetic acid during the act of fermentation.

2d. Is the formation of acetic acid always preceded by the production of alcohol, in the same manner as the production of sugar precedes that of alcohol in the vinous fermentation?

3d. What are the substances which may serve as a ferment for the acetous fermentation, and what are the essential characters of these kinds of fermentation?

4th. What influence does the air exert over the acetous fermentation? Is its presence essential? In which case, how does it act? Is its office the same as in the alcoholic fermentation, or, if absorbed, does it become a constituent part of the acid, or give rise to foreign products.

5. Finally, To establish a theory of the acetous fermentation in harmony with all the facts observed.

The memoir to be written in French or Latin, and to be delivered to M. Henry, Secretary of the society, before the 1st of April, 1827. A motto is to be attached to the paper, corresponding to that on a sealed packet, containing the name of the author.—*Journal de Pharmacie, Feb.* 1826.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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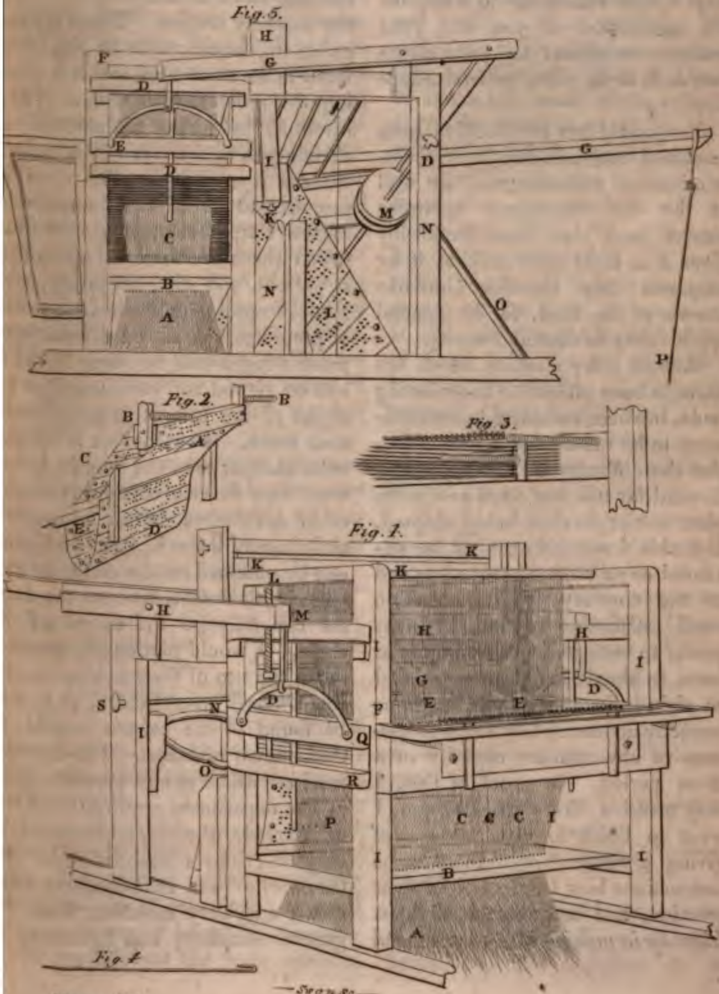
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

"Expert men can execute, and judge of particulars *one by one*; but the *general* counsels, and the plots, and the marshalling of affairs, come best from those that are learned."—*Lord Bacon.*

No. CXXXI. *Saturday, 24th June*, 1826. Price 3d.

NEW WEAVING MACHINE.—Invented by Glaud Wilson.



WEAVING MACHINE.

Gentlemen,—On the annexed sheet is a drawing of my new Weaving Machine, respecting which you wrote me last week.

From want of practice, I have not much facility in the use of the pen, therefore, cannot now enter into so minute an explanation respecting the peculiar merits of my invention, as I would wish to have done. I will, however, in the best way I can, endeavour to state, for the satisfaction of you and your readers, its claims on your attention and to its more general adoption.

Frequently has my machine been examined and admired by the discriminating manufacturer, as well as by the intelligent operative weaver, and they have uniformly given it as their opinion, that it far surpasses any machine hitherto known of the kind, for its general applicability to common works.

Almost every machine which has hitherto been offered to the weaving trade, has been considered so complicated in its nature and construction, that the difficulty of bringing them forward for use, has acted as a complete barrier to their being adopted. But this fortunately cannot be advanced as an objection to mine, and on the contrary, it affords me no small satisfaction to have it in my power to state it, my machine is, at once, so simple in its structure, and so plain in its movements, as to be perfectly understood by every tradesman of any ordinary capacity in a short period. In proof of this, I may mention, that some time ago, I went to Beith for the purpose of giving a weaver-wright there some instructions how to proceed in their erection, and had not the slightest difficulty in making him comprehend all that was requisite to proceed with the job. He has since made twelve, all of which are doing well. And in putting them into operation, no more difficulty is felt; a boy of twelve years of age can now work with them and with much more ease and facility than with the draw-boy. It has now been applied to work lyon double figured handkerchiefs which formerly took two draw-boys, and the cloth is found to be superior in every respect. There is one going in Dumfermline in the Damask table cloth line, and it is giving the greatest satisfaction. The inventor, by giving the machine a double power, has been able to introduce it to Kilmarnock, where it promises to be of vital importance in the Carpet manufacture of that town: there are three in operation at present, and some preparing, and I am of opinion that when the storm of prejudice has subsided (which at present rages with so much fury) it will be viewed and considered as an object of the utmost importance in their trade. The machine is 50 per cent. cheaper than the one in common use; besides combining many other advantages, it can be erected under a roof 9 feet high, and a figure can be obtained on the cloth, to any conceivable extent, whereas the barrel can only go the extent of its circle. I would particularly recommend the use of the machine to the silk Damask manufacture, as it will be found of the utmost benefit to that branch of trade. The French machine which is now partially used in that department requires 9 inches of a tread, whereas mine requires only 5, this is acknowledged by those who have examined my machine, and they consider, from its general simplicity and lightness, it will yet be regarded as an important improvement.

When we calmly survey the structure and operation of this machine, we have no hesitation in declaring, that if it had not been the unparalleled depression of our trade it would long ere this have been familiar to the minds of many of your readers through a different medium than that of your columns; however, we must thank you for your unremitting exertions, to give it publicity, and in bringing the public mind to bear on its merits. I have, however, done my best upon it, and will still do more, for I am yet busily engaged in concocting schemes by which it may be improved and rendered still more useful. But after all, should my schemes be rendered abortive—and should they never be universally adopted, I will at least have the consolation in my own mind of knowing that they have neither been chimerical nor difficult to be put in operation. "A prophet has no honour in his own country;" however, and although neither prophet nor priest my fate may be that of the prophet's.

I will be most happy at any time to hear from you, and if any inquiries should be made respecting my machine or me, you will be so good as refer your inquirer to me,—I am,

Yours, respectfully,

Claud Wilson.

Paisley, 20th June, 1826.

Description of the Plate.

Fig. 1.—A is a representation of the harness. B is the neck board through which the harness passes when drawn. C C C are the note cords which, passing through the draught board, go upwards and are then attached to the suspending boards. D D are circles attached to the draught board for moving the machine *on the lever scheme.* E E is a view of a spring fixed into the back part of the machine. F is the opposite end of the spring, which is attached to the bottom of the sword of the lay in which the cylinder works. G is a representation of the needles through which the note cords pass. H H H is the lever which lifts the draught and gives lightness and despatch in the power of wearing. I I I I is the frame or the carriage. K is the board to which the harness is suspended. L is the top of the lay, in which the cylinder walks. M is the lever with which the lay is pulled out, it is by this operation the lash is turned. N is the top sneck of the cylinder. O is the lower sneck by the operation of which the figure is made to go either up or down as may in the mean time be required. P are the cords where the pasteboard figures are suspended. It is by these pasteboard figures the ornaments on the cloth are made. Q is the side draught-board, a bolt is fixed in it for the purpose of keeping it steady. R is a rail wherein a brass bush is fixed in the centre. S is a small wheel by the operation of which the cylinder is moved out to turn the card P.

Fig. 2.—A is the representation of the cylinder which moves round the cards for making the figures. B B is a wire spring used for the purposes of bringing too the cylinder. C is a skrew by the application of which the cylinder is heightened or lowered. D is a flat board where the cords pass in going round the cylinder. E is a roller where the cards pass over.

Fig. 3. represents the heights or back part of the needle.

Fig. 4. is a drawing of the needle itself.

Fig. 5.—A is a representation of the harness. B is the neck board. C the uprights or note

cords, the cross lines are the needles. D D the board through which the bolt passes. E is the draught board. F the board to which the harness is attached. G the lever for drawing the draught. H is a skrew where the lay which holds the cylinder is hung by. I is the lay. K is a skrew for heightening or lowering the cylinder. L are the cards. M is a wheel by the action of which the cylinder is moved out. N is the frame. O is a cord for turning the cylinder and the wheel M. P is a cord for lightening the draught.

ON MECHANIC SCHOOLS AND ON POLITICAL ECONOMY AS A BRANCH OF POPULAR EDUCATION.

By Thomas Chalmers, D. D.

(Continued from page 221.)

It, in the first place, can be made abundantly obvious to the general understanding, that the price of an article has a certain and necessary dependence on the two elements of demand and supply; and so, on the one hand, that the buyers can promote their interest of lessening its price, by lessening their demand; and that the sellers can promote their interest of raising its price, by lessening the supply. The principle is too elementary to be dwelt upon here at length, yet, nevertheless, might, with its many instances and illustrations, be made the subject of a most pleasing and popular lecture; and might, when once in thorough possession of the mechanic scholars, be subsequently turned into the instrument of many precious applications. It might be made, in fact, to neutralize, or to sweep away the most inflammatory of those topics wherewith the radical orator seeks to irritate the passions, and to enlist upon his side, the violence of the multitude—that multitude, of whom it has been well said by Talleyrand, that we have nothing to fear, if we but treat them with frankness; and over whom, so soon as we carry their reason and their sense of justice along with us, we are sure to gain a resistless ascendancy.

On the strength of this single doctrine, it will not be difficult to convince them, first, that in the scarcity of any article, when the supply is small, they are not properly the sellers, but the buyers who make the price. It is the competition of those who are in want of the commodity, and fear that they cannot get enough—it is this which is the efficient cause of its dearness. In the higglings of a market, it is often the seller who names the price, and hence the popular imagination that he makes it. But substantially the juster view of the case is, that the buyer offers the price. The dealer, in fact, would have sold it at a lower price to one customer, had not another customer, more urgent than he, been willing to give a higher price for it, rather than want it altogether. The odium of the high price is cast upon the merchant, whereas, at each given state of the supply, it may be regarded as wholly the creation of the purchasers. He no doubt takes the highest price that he can get; but this is only saying that he takes the highest price which any buyer is willing to give, rather than suffer the inconvenience of wanting it. In other words, it goes to him who is most eager to obtain it; and, had it gone to another, or which is the same thing, had it sold at a rate beneath that market price to which it would be brought by the free and natural competition, it would have been an act of favouritism to one, but at the expense to another, of a sorer and heavier disappointment. The vender, in closing with the highest prices for his article, just sends it to those places where there is the most intense feeling of its necessity. The interest of the dealer is at one with the interest of the public; for, in taking the highest offer, he is just sending his commodity to the quarter where it is most needed and desired. It is thus that the streams of commerce are made to flow towards the places of greatest vacancy; and any violence by which this process is thwarted, for the relief of suffering and destitution in one place, must be at the expense, in another place, of a suffering still more intense, of a destitution still more grievous.

It is by a train of simple argumentations like these, that Smith's great lessons upon the corn trade might be still further extended and brought home to the popular understanding. They are all of them eminently fitted to allay the passion and prejudice of the working classes. They are not the farmers, or the middlemen, who make the high prices in a year of scarcity. They are the purchasers, each intent upon his own share, and each labouring to outbid his fellows. This may not be ostensibly, but it can be easily demonstrated even to the satisfaction of the most plebeian student, that this is virtually the process. It is not the growers, or carriers of the corn, who fix its price. They are the consumers of the corn: and to force the sale of it at a lower price than that at which the free operation of the market would settle it, is just to wrest the food of our land *from those whose necessity is* most urgent, and shift its direction to those whose necessity is less so. There cannot be a doubt that there would be more of acrimony and bad blood excited by such a restraining policy, than when the trade is left to its own spontaneousness. This surely is a lesson fitted to pacify, and not to exasperate. To expound a doctrine like this, is not to scatter mischief among the people. It would act, in truth, as an emollient upon their feelings. And whether it be the reasoning and reflective process, which, in a mechanic school, they might be made to undergo, or this conclusion of a sound political economy to which it carried them, there is not only wisdom, but the meekness of wisdom in them both.

But a still more important application of the elementary doctrine on the subject of prices, is, that when instead of a scarcity, there is the overabundance of any article, the low price to which it falls may be regarded more properly as the deed of the sellers, than that of the buyers. All the keenness of the competition is transferred, in such a state of the market, from the latter to the former. The anxiety is now on the side, not of the customers to obtain goods, but of the traders to dispose of them. For this purpose, each tries to undersell his neighbour; and as in the first process, we saw that they were the consumers who made the ascent from one step to another, in the lifting up of price, so in the second process, we see that they are the venders who make the descent in the letting of it down. In a season of dearness, you cannot blame the merchant for taking the highest price which men will consent to give; and if blame in the matter attaches to any, it must be to the other party who offers it. In a season of cheapness, you cannot blame the purchaser for taking the article at the lowest terms on which he finds the seller willing to part with it. It is not his doing, but the doing of him who holds the commodity. It is thus that we cannot carry the pupils of this science, a very little way into the interior mechanism of trade, without reversing to their eye the first aspects of things; and we are persuaded, that in these very first, and in all their future advances in this philosophy, it will be found, at every step which is correctly taken, that the alliance is most intimate between the spread of philosophy in a nation, and the stability of its peace.

The exemplification of this last doctrine, in which the attendants of a mechanic school have the greatest interest, is that which regards the price of labour. It is not a tangible commodity, but liable to the same laws of variation in price with every other commodity which is brought to market, or which can be made in any way the subject of a bargain. It is exposed to the fluctuations of a greater or a less demand, and it might be furnished at a greater or less rate of supply. The labourers of our land are the sellers of this article; and it is virtually they who fix and determine the price of it. The buyers are those who employ them; and they are not to blame because of the miserable price which they give for labour for this is the price at which the other party have offered it. The true cause, at any time, of a depression in the wages, or the price of labour, is not that masters have resolutely determined to give no more, but that servants have agreed to take so little. The infuriated operatives, instead of looking to capitalists as the cause of their distress, should look at one *another.* They would have greatly more reason, at a time of well-paid labour, to look to capitalists as the cause of their high wages, than to look to them as the cause of their low wages, at a time of ill-paid labour. In the one season, it is the overbidding of each other for labour, by the masters, which is the efficient cause of its high price. In the other season, it is the underselling of each other, by the labourers, which is the efficient cause of its low price. Whatever be the external complexion, this is the substantial character of these transactions; and this might easily be made to appear to the disciples of a popular economic course, among the foremost revelations of the science. It is a science, through the arcana of which, the ordinary attendants on a school of arts are abundantly capable of being led, and we should confidently look for patience, and peace, and charity, as the practical fruits of it.

A master may require one additional workman, but may have no use whatever for two. Two, however, may offer themselves, whereof the first is willing to serve him for two shillings a-day, and the second, rather than be without employment, would thankfully agree for one shilling and sixpence. It is not the master's fault that he has hired in a labourer at this lower wage. It is the doing of the labourer himself, and not his doing. He would, in fact, have inflicted a sorer disappointment, by accepting the proposal of the first, and rejecting that of the second, than by closing as he has done, with the inferior offer. He would, at least, have withheld the employment from him who stood most urgently in need of it. He would have refused admittance to the man who, by the very terms of his proposal, made demonstration before him of the most abject necessity. There is odium cast upon the masters, in every season of depressed wages; but the truth is, that, did they reverse their proceedings, and acquiesce in the higher demand, while they rejected the lower offer, they might inflict a suffering still more grievous, and perhaps incur an odium still more implacable. It is felt as all the greater hardship, when one man's solicitation for work has been declined by the master, though upon more favourable terms, while another, upon terms less favourable for the master, has been preferred before him. It is not, in fact, the hard-hearted tyranny of masters which has brought down the wages of workmen. It is the imploring cry of the most helpless among themselves, craving a participation with their fellows, and offering to be satisfied with a smaller share, rather than be outcasts altogether. The lowness of the wage is, in fact, all resolvable into the excess of their own numbers. And, in every season of ill-paid work, the true character of transaction between masters and workmen, is not that masters refuse to give a greater wage, but that workmen consent to take a less one.

There could, after this, be explained the cause of those periodic depressions which take place in the wages of manufacturing labour, and the way of averting it—even, as we have already stated, by an accumulated capital in the hands of workmen. And, even although the economical lecturer could point out no remedy for this state of things, there would be a salutary and pacific influence in his demonstration of the causes which produced it. It is well when workmen are convinced, that the low price of labour is not what they at first sight imagine, the doing *of their proud oppressors*; but the fruit of a necessity over which masters have no control. If wages were at the fiat of their employers, why are they ever permitted to rise at all, and often treble at one time their amount at another? But these tides of fluctuation, at one time adverse, and at another favourable for one or other of the parties, are set a-going by different forces altogether from the arbitrary will of capitalists; and it must serve to disarm the hostility of the humbler, for the higher classes, when they are made to understand that the ebbs and flows of a labourer's prosperity, depend upon the laws of a mechanism for which their masters are as little responsible as they are for the laws of the planetary system.

But what should make an acquaintance with political economy so valuable to the working classes, is, that a remedy can be pointed out. The low price of labour is as much the doing of the labourers themselves, as the low price of a commodity is the doing of the dealers, who, in the case of an excessive supply, undersell each other. Their only relief is in the limitation of the supply; and there is positively no other permanent or effectual relief for the low wages of labour. All that combination can effect in this way, is but partial and temporary; and it is only by lessening of the proportion between the number of labourers, and the demand for labour, that the working classes will ever find themselves on a stable and secure vantage-ground. They have no command over the second term of this proportion. They cannot increase the demand for labour. But they have full command over the first. They can restrain the supply of labourers. A general conviction of this amongst our work-people would go far to tranquillize them. It would wean them, at least, from all vain and hopeless experiments. Even though they should despair of any immediate result from that expedient which is alone effectual; yet it is well for them to know that it is the only expedient, and that there is no other. It may at least keep them from idly or mischievously rambling in pursuit of other expedients; and, far better corrective to that general restlessness of our mechanics and labourers, which of late has so alarmed us, than the force either of our statute or common law against combinations, would be the spread of an enlightened conviction among them of their total inefficacy.

But though no immediate effect on the wages of labour could accrue from any change in the habit of labourers, yet the effect would be far speedier than is generally counted upon. And this were one of the most important lessons that could be urged or expounded among the disciples of a mechanic school. It were not at all difficult to manifest to their understandings, that a very slight excess in the number of labourers, creates a very great reduction in the price of labour; and so conversely, that it may only require the lopping away of a very small excess to elevate, from a state of very sunken debasement, the condition of an overpeopled land. It would serve to remove from their minds the despair of any quick or great amelioration; when made to perceive on how minute a difference in the number of labourers, there turns a most momentous difference in the remuneration which is given to them. And if, in any manufacture, as in that of weaving, for example, there should be a small overplus of hands, and so a great depression of wages, *it is not by the* instant and forcible *exclusion of this* overplus that the relief is arrived at. It may be obtained by a more quiet and gradual, but withal a very speedy operation. Simply, let the egress at the one end of individuals from the general body of weavers, by old age or death, not be so fully replaced as heretofore by the ingress of apprentices or new hands at the other. Let there be somewhat of a slackening in the annual supply; and this, in a few years, will lighten the competition for work, by at least some small yet sensible fraction of the sum total of operatives; a fraction which, though minute in itself, would be mighty in its consequences, and would tell with effect on the general circumstances of the whole body. This were the treatment by which the workmen, however low they may have fallen in any branch of trade, might be restored to a state of sufficiency and respect; and there is no other treatment by which we ever can accomplish any great or general ascent in the circumstances of a whole population. It is not by a sudden excision of the overplus that relief is arrived at. Even though a single year of emigration should take off the whole redundancy, a very slight increase of the births would speedily fill up again the room which had been left; and a land will always be peopled up to the degree at which its inhabitants hold existence to be tolerable. It were better that they aimed at something higher and more dignified than a barely tolerable existence; and so, that the population were kept considerably within the limits of its utmost possible extension. But this can only be done by the taste and habits of the people themselves; by a rise in their standard of enjoyment; by a consequent shifting forward in the average period of their marriages, and so a lighter progeny wherewith to burden and oppress the coming generation. And to accomplish a desirable change, so very great a stride, as some may apprehend, would not be indispensable, and far less any thing like a revolution in the customs of society. That very gradual refinement of soul, which might be achieved among the people by their now improving education; that small, though perhaps nearly insensible effect which this is calculated to have on the time of their entering upon families; and hence the almost imperceptibly fewer births that will take place in the country:—these are the sure, though simple means of that enlargement which we believe to be awaiting the peasantry of our land. A very small oscillation in the wages; and so when their translation is effected into a state of comfort and sufficiency which they have never yet experienced, this change, momentous as it is, will proceed in a way so gentle and so noiseless, that it may truly be said of it, " it cometh not with observation."

Now all this might be set forth with enough of clear and commanding evidence for the understandings of the common people. With all the incredulity which they feel about the philosophy of Malthus, they recognize the whole truth and application of it in particular trades; and when they combine, as they have often done, to limit and restrain the admission of apprentices into their own craft, they are just lending their testimony to the obnoxious theory of population. A smaller general population will supply fewer apprentices; and this favourite object of theirs, and which they have tried to effectuate by forcible exclusions, can be rightly arrived at in no other way, than by that which the philosophy of Malthus has expounded. *And here may be exposed* with effect, the odious and unjust character of many of their combinations—in that, by dictating the number of apprentices they are acting in the unfair and illiberal spirit of monopoly. They are quite vehement against the alleged tyranny of masters; yet, in this instance, they may well be charged with having become the tyrants and the oppressors themselves. They would enact corporation laws in their own favour; and, under the pretext of obtaining security against the aggression of their hostile employers, they would, in fact, be the restrictions which they propose upon the employment, commit an act of most glaring hostility against the families of all other workmen save their own. It is thus that each distinct trade would form itself into its own oligarchy; and in no possible way could a system be devised more fatal to real liberty, and more full of annoyance to the general population. We are confident, that a lecturer of any talent at all might, upon this subject, carry the most crowded amphitheatre of plebeian scholars along with him. He might, in the first instance, gain their compliance with the whole of Smith's argument on the subject of free trade. He might enlist them on the side of competition, and make them partake in his own indignation against the hatefulness of monopoly. He might thus prepare his way for entering upon the subject of combinations; and, however fair or innocent he might allow them to be in themselves, yet, on the strength of such principles as he had just expounded, he might feel himself on high vantage ground for disarming them of all their evil, by denouncing whatever is wrong or mischievous in their practices. All the terror, and outrage, and forcible exclusion, which they have at any time directed, whether against new apprentices or workmen—the enormity of these he could make quite palpable to the popular understanding; and would, I am persuaded, be borne along on the tide of popular sympathy, when, in the midst of his applauding hearers, he lifted, against dictation in all its forms, the honest remonstrances of justice and liberty; and advocated the general rights of the population, whether against the now exploded oppressions of the statute-book, or the still sorer oppression of upstart and recently organized bodies among themselves. It is not through bearing down the passions by the force of law, but through forming and enlightening the principles of the commonalty by the force of instruction, that the present fermentations are to be allayed. And we despair not of the day when the science of political economy, instead of being dreaded as the instrument of a dangerous excitation, will be found, like all other truth, to be of powerful efficiency in stilling the violence of the people.

On this branch of the subject, there is one invaluable result, that might be obtained from the demonstrations of a lecturer; and that is, a conviction, on the part of his hearers, that pauperism was in truth their worst enemy, though their enemy in disguise, and that it had a most depressing effect on the wages of labour, and the real comfort of the labourers.

(*To be concluded in our next.*)

GOLD-LEAF

USUALLY signifies fine gold beaten into plates of an exceeding thinness, which are well-known in the arts of gilding, &c. The preparation of gold-leaf, according to Dr. Lewis, is as follows: "The gold is melted in a black-lead crucible, with some borax, in a wind-furnace, called by the workmen a *wind-hole:* as soon as it appears in perfect fusion, it is poured out into an iron ingot mould, 6 or 8 inches long, and ¾ of an inch wide, previously greased, and heated, so as to make the tallow run and smoke, but not take flame. The bar of gold is made red-hot, to burn off the unctuous matter, and forged on an anvil into a long plate, which is further extended, by being passed repeatedly between polished steel rollers, till it becomes a ribbon as thin as paper. Formerly the whole of this extension was procured by means of the hammer, and some of the French workmen are still said to follow the same practice: but the use of the flatting-mill both abridges the operation, and renders the plate of more uniform thickness. The ribbon is divided by compasses, and cut with scissors into equal pieces, which consequently are of equal weights: these are forged on an anvil till they are an inch square; and afterwards well nealed, to correct the rigidity which the metal has contracted in the hammering and flatting. Two ounces of gold, or 960 grains, the quantity which the workmen usually melt at a time, make 150 of these squares, whence each of them weigh six gr. and two-fifths; and as 902 grains of gold make a cubic inch, the thickness of the square plates is about the 766th part of an inch.

"In order to the further extension of these pieces into fine leaves, it is necessary to interpose some smooth body between them and the hammer, for softening its blow, and defending them from the rudeness of its immediate action, as also to place between every two of the pieces some proper intermedium, which, while it prevents their uniting together, or injuring one another, may suffer them freely to extend. Both these ends are answered by certain animal membranes.

"The gold-beaters use 3 kinds of membranes; for the outside cover, common parchment made of sheep-skin; for interlaying with the gold, first the smoothest and closest vellum, made of calf-skin; and afterwards the much finer skins of ox-gut, stript off from the large straight gut slit open, curiously prepared for this use, and hence called *gold-beaters' skin*. The preparation of these last is a distinct business, practised by only two or three persons in the kingdom, some of the particulars of which I have not satisfactorily learned. The general process is said to consist in applying one upon another, by the smooth sides, in a moist state, in which they readily cohere and unite inseparably; stretching them on a frame, and carefully scraping off the fat and rough matter, so as to leave only the fine exterior membrane of the gut; beating them between double leaves of paper, to force out what unctuosity may remain in them; moistening them once or twice with an infusion of warm spices; and lastly, drying and pressing them. It is said, that some calcined gypsum, or plaster of Paris, is rubbed with a hare's foot both on the vellum and the ox-gut skins, which fills up such minute holes as may happen in them, and prevents the gold-leaf from sticking, as it would do to the simple animal membrane. It is observable, that, notwithstanding the vast extent to which the gold is beaten between these skins, and the great tenuity of the skins themselves, yet they *sustain continual* repetitions of the process for several months, without extending or growing thinner. Our workmen find, that after 70 or 80 repetitions, the skins, though they contract no flaw, will no longer permit the gold to extend between them; but that they may be again rendered fit for use by impregnating them with the virtue which they have lost, and that even holes in them may be repaired by the dexterous application of fresh pieces of skin; a microscopical examination of some skins that had been long used plainly shewed these repairs. Another method of restoring their virtue is by interlaying them with leaves of paper moistened with vinegar white-wine, beating them for a whole day, and afterwards rubbing them over as at first with plaster of Paris. The gold is said to extend between them more easily after they have been used a little than when they are new.

"The beating of the gold is performed on a smooth block of black marble, weighing from 200 to 600 pounds, the heavier the better; about nine inches square on the upper surface, and sometimes less, fitted into the middle of a wooden frame, about two feet square, so as that the surface of the marble and the frame form one continuous plane. Three of the sides are furnished with a high ledge; and the front, which is open, has a leather strap fastened to it, which the gold beater takes before him as an apron, for preserving the fragments of gold that fall off. Three hammers are employed, all of them with two round and somewhat convex faces, though commonly the workman uses only one of the faces; the first, called the *catch hammer*, is about 4 inches in diameter, and weighs 15 or 16 pounds, and sometimes 20, though few workmen can manage those of this last size;

the second, called the *shodering hammer*, weighs about 12 pounds, and is about the same diameter; the third, called the *gold hammer* or *finishing hammer*, weighs 10 or 11 pounds, and is nearly of the same breadth. The French use 4 hammers, differing both in size and shape from those of our workmen; they have only one face, being in figure truncated cones. The first has very little convexity, is near five inches in diameter, and weighs 14 or 15 pounds; the second is more convex than the first, about an inch narrower, and scarcely half its weight; the third, still more convex, is only about two inches wide, and four or five pounds in weight; the fourth or finishing hammer is nearly as heavy as the first, but narrower by an inch, and the most convex of all. As these hammers differ so remarkably from ours, I thought proper to insert them, leaving the workmen to judge what advantage one set may have above the other.

"A hundred and fifty of the pieces of the gold are interlaid with leaves of vellum, three or four inches square, one vellum leaf being placed between every two of the pieces, and about 20 more of the vellum leaves on the outsides; over these is drawn a parchment case, open at both ends, and over this another in a contrary direction, so that the assemblage of gold and vellum leaves is kept tight and close on all sides. The whole is beaten with the heaviest hammer, and every now and then turned upside down, till the gold is stretched to the extent of the vellum; the case being from time to time opened for discovering how the extension goes on, and the packet, at times, bent and rolled, as it were, between the hands, for procuring sufficient freedom to gold, or, as the workmen say, to make the gold work. The *pieces taken out* from between the vellum leaves, are cut in four with a steel knife; and the 600 divisions, hence resulting, are interlaid in the same manner, with pieces of the ox-gut skins 5 inches square. The beating being repeated with a lighter hammer, till the golden plates have again acquired the extent of the skins, they are a second time divided in 4; the instrument used for this division is a piece of cane cut to an edge, the leaves being now so light, that the moisture of the air or breath condensing on a metalline knife. These last divisions being so numerous, that the skins necessary for interposing between them would make the packet too thick to be beaten at once; they are parted into 3 parcels, which are beaten separately with the smallest hammer, till they are stretched for the third time to the size of the skins; they are now found to be reduced to the greatest thinness they will admit of, and indeed many of them before this period break or fail. The French workmen, according to the minute detail of this process given in the *Encylopedie*, repeat the division and the beating once more; but as the squares of gold, taken for the first operation, have four times the area of those used among us, the number of leaves from an equal area is the same in both methods, viz. 16 from a square inch. In the beating, however simple the process appears to be, a good deal of address is requisite for applying the hammers so as to extend the metal uniformly from the middle to the sides; one improper blow is apt not only to break the gold leaves, but to cut the skins.

"After the last beating, the leaves are taken up by the end of a cane instrument, and being blown flat on a leather-cushion, are cut to a size, one by one, with a square frame of cane made of a proper sharpness, or with a frame of wood edged with cane; they are then fitted into books of 25 leaves each, the paper of which is well smoothed, and rubbed with red-bole to prevent their sticking to it. The French, for sizing the leaves, use only the cane-knife, cutting them first straight on one side, fitting them into the book by the straight side, and then pairing off the superfluous parts of the gold about the edges of the book. The size of the French gold leaves is from somewhat less than three inches, to three and three quarters square; that of ours, from 3 inches to three-eights.

"The process of gold beating is considerably influenced by the weather. In wet weather, the skins grow somewhat damp, and in this state make the extension of the gold more tedious: the French are said to dry and press them at every time of using; with care not to over-dry them, which would render them unfit for further service. Our workmen complain more of frost, which appears to affect the metalline leaves themselves: in frost, a gold-leaf cannot easily be blown flat, but breaks, wrinkles, or runs together.

"Gold-leaf ought to be prepared from the finest gold; as the admixture of other metals, though in too small a proportion to sensibly affect the colour of the leaf, would dispose it to the loss of its beauty in the air. And indeed there is little temptation to the workman to use any other; the greater hardness of alloyed gold occasioning as much to be lost in point of time and labour, and in the greater number of leaves that break, as can be gained by any quantity of alloy that would not be at once discoverable by the eye. All metals render gold harder and more difficult of extension: even silver, which in this respect seems to alter its quality less than any other metal, produces with gold a mixture sensibly harder than either of them separately, and this hardness is in no art more felt than in the gold-beaters.

The French are said to prepare what is called the *green gold-leaf*, from a composition of one part of copper and two of silver with eighty of gold. But this is probably a mistake: for such an admixture gives no greenness to gold: and I have been informed by our workmen, that this kind of leaf is made from the same fine gold as the highest gold-coloured sort, the greenish hue being only a superficial tint induced upon the gold in some part of the process: this greenish leaf is little otherwise used than for the gilding of certain books.

"But though the gold-beater cannot advantageously diminish the quantity of gold in the leaf by the admixture of any other substance with the gold, yet means have been contrived, for some particular purposes, of saving the precious metal, by producing a kind of leaf called *party-gold*, whose basis is silver, and which has only a superficial coat of gold upon one side: a thinner one of gold, laid flat on one another, heated and pressed together unite and cohere; and being then beaten into fine leaves, as in the foregoing process, the gold, though its quantity is only about one-fourth of that of the silver, continues every where to cover it, the extension of the former keeping pace with that of the latter."

LETTERS AND QUERIES.

Gentlemen,—The annexed letter I beg leave to submit to you; not for any thing in itself interesting, or useful; but to serve as a key to the *reply*, which, if I mistake not, shall be found to throw a deal of light upon that intricate part of Grammar, which is the sole subject of it.

Heteroclite.

"To Mr. John Gemmel, A. M.

"Dear Master,—Of all the barriers which lie in my grammatical road, the subjunctive mood I find the most insuperable: Will you, Sir, subjoin your aid, else I shall fail—for ever fail, to arrive at any thing like *potential* in literature! The subsequent rules and phrases, it bids *imperative* defiance to my *infinitive* efforts, to reconcile or methodize.

"The subjunctive mood," says Lennie, "represents a thing under a condition, supposition, motive, wish." Yet the same learned author in page 152, states, that "if thou *have* done thy duty—unless he *have* brought money—if thou *will* grant my request,—should be if thou *hast* done,—unless he *has* brought—if thou *wilt* grant." And yet again in page 89, "conjunctions that imply contingency and futurity, require the subjunctive mood." Now, Sir, the phrase if thou *will* grant my request, already quoted, it strikes me, implies both contingency and futurity, and the other, namely, "unless he *have* brought money," I should consider at least contingent.

"The translators of the sacred volume, it should seem were, like myself, a little perplexed. For instance, Heb. viii. 8. Though he *were* a son, Lev. xxvi. 6. Unless he *wash* his flesh. Gen. xxiv. 42. If now thou *prosper* my way. John xix. 12. If thou *let* this man go. Pray how is it that the 2d and 3d persons here speak in the subjunctive mood, and the identical same persons elsewhere made to speak in the indicative? for instance,—2. Cor. viii. 9. Though he *was* rich. Deut. xxviii. 15. If thou *wilt* not hearken. Mat. xviii. 2. If thou *wilt*, thou canst make me clean. This, master, is the point that quite puzzles me!

"Hypothetical, conditional, concessive, and exceptive conjunctions," says Lowth, "seem in general to require the subjunctive mood." Were we allowed in general to make this rule our standard, we should in general write thus:

Sing.—1. If I have. Though I have. Unless I have. Except I have.
2. If thou have. Though thou have. Unless thou have. Except thou have.
3. If he have. Though he have. Unless he have. Except he have.

But to this rule no author, that I can consult, either sacred or profane, adheres uniformly.

Wherefore, Dear Master, of the path direct, if there be any—to lead out of this chaos, be pleased, by return of post, to develope something *indicative*. You would not surely have your pupil to settle contented with the grammar of the vulgar throng of men, that *Knows* nothing of moods, nor *does not* desire to know, with the desire of

L. M'L."

Island of Coll, May 27th, 1826.

Gentlemen,—A long indisposition alone has prevented me from taking advantage of your kind permission of sending to you the following inquiries for insertion, into your valuable publication.

Should you deem them worthy of your notice, you would confer an unspeakable favour by presenting them to the public, as by so doing, it would give me that wished for opportunity of information upon such subjects.—Permit me, **Gentlemen**, to subscribe myself,

Your most obedt.
S. V. P.
Capt. in the Prussian Army.

Leith, June 17th, 1826.

1. In a well-formed ball, the point of gravity and the centre of it fall always in one and the same point; but very often the inequality of the material chiefly, in cast balls, separate these two points from each other.

Does there exist any instrument to

find out if this difference happens, and to what degree?——or:

Can you, or any of your ingenious readers, invent an instrument for this purpose, applicable to balls from three to twenty inches in diameter, at once simple and practicable?——

2. In a description given of the Carron-works, near Falkirk, in the Edinburgh Encyclopædia, by Dr. Brewster, Vol. V. Part II. page 555; is the following paragraph.

"In former times all the ordnance made here, were tried with the full powder proof, before sent from the works, but they are now only proved by water forced into the chamber by a very powerful engine."—A complete description, and drawing of this machine, as it is really now in use, would be of the greatest importance.

3. It is requested to have a complete description and drawing of the instrument, improved and introduced at Woolwich, by General Dessaulier, to examine the correctness of the bore of a cannon, and the evenness of its interior surface *at every point;* or does there exist another instrument, which indicates, *with the utmost nicety all the faults,* which may have happened during the bore of a hollow cylinder, in the direction of the bore itself, or upon the interior surface of it.

4. What machineries are now with success really in use, for cleaning the bottom of harbours, canals, &c., which lie not too deep under water?——The machine either moved by men, horse or steam.

[The best invention for this purpose which has ever yet been brought into use is the dredging machine now in use on the river Clyde. It is described in No. 39, Vol. II. of our Magazine.—*Eds.*]

5. What instruments exist, to ascertain the exact and just necessary power for moving any carriage?——

6. What means or instruments exist to know the degree of hardness or softness of metals *before and after* they are cast or wrought? Ex. in metal guns, iron axle-trees, tyres of wheels, &c.

7. What means are adapted to preserve the immense number of sets of harness, and other leathern articles, and the ropes, cables, &c. in Woolwich?——

8. The old ram machine to drive piles and timbers into the ground, is too well-known with all its many faults and dangers, therefore it is requested to know if such a machine of a new construction has been really in use, which produces the same effect, but can be worked with less hands, and less danger to the men?

GENTLEMEN,—I am not much in the practice of writing for the public, and as little I do assure you for the ladies, I am, therefore, rather afraid to venture to address you, in reply to your fair, though inquisitive correspondent, "*Eliza,*" "*Hutcheson Street,*" respecting some of her queries. I think, however, I can in my own plain way, tell her how to manage the unwelcome guests who seem to domesticate themselves so much in her house, to the annoyance of the inmates. First, then,

To drive away or prevent the approach of Moths.—Wrap up yellow or turpentine soap in paper, or place an open bottle containing spirits of turpentine within the wardrobe; or should the smell of the latter be unpleasant to the more delicate senses of the ladies, other cures equally powerful in their effects, as also less obnoxious, may be adopted:—Sprinkle bay leaves, lavender, or walnuts, black pepper in grains, or Russia leather cuttings, plenty of which may be had on applying to any book-binder. Secondly,

To banish the Beetle or Clock.—This little insect has a most beautiful appearance when viewed with candle light; or when viewed microscopically, it presents a most wonderful picture of mechanical ingenuity. I would not therefore propose the destruction of it, but would "recommend it to mercy."—To get rid of it, however, all that is necessary to be done, is to throw a little unslockened lime in the immediate vicinity of its residence. It cannot bear to place its feet on the top of this, and rather than endure the pains and penalties of doing so, it will decamp altogether. Recollect I speak from experience. I am none of your speculative folks. Snuff also has the effect of expelling these insects, but it is apt to kill them; so I would not recommend any person who stands in awe of Mr. Martin (late M. P.) to adopt this article. It is more expensive also, particularly if you use the *real Persian*, which is unquestionably the best of all snuffs, not only for this purpose, but also for exciting an agreeable titulation in the extremities of the olfactory nerves.

If your correspondent is a Botanist, she will know of an herb which grows wild in our country, marshy ground, called black hellibore, or more learnedly, Viratum Vireæ. The roots of this also will prove quite effectual in accomplishing the desired end.

Yours,

J. B.....

Portland Street.

DESTRUCTION OF BUGS.

GENTLEMEN,—In answer to your learned correspondent, ι. ω. ν. γ. ϖ. λ. δ. who writes in p. 64, No. 118, wishing for an effectual plan to destroy this obnoxious vermin, I would recommend the use of *Train Oil*; It is a simple, cheap, and easily obtained article, and nothing could possibly be more immediate or more destructive in its effects. The only objection to oil, is the disagreeable smell which it produces. But this is of short duration. The fresh air admitted for a short time into the room will soon dispel it. Many other methods have been pointed out by great folks. And among others has the author of John Murray's stupid jumble of nonsense in what he is pleased to call *The Family Receipt Book*, found an effectual cure. He recommends the fumigation of the room with saltpetre and brimstone, on the grounds, that because they destroy human life, *ergo*, they will destroy bugs. Reasoning worthy of the enlightened author of the Family Receipt Book, as well as of the still more enlightened publisher of the *Rep* ! !

Your's,

SARAH ——.

Dolly's Chophouse, Paternoster Row, London.

MISCELLANIES.

On predicting the weather.—From a very great number of meteorological observations, made in England between the years 1677 and 1789, Mr. Kirman has deduced the following conjectures of the weather:—

1. That when there has been no storm before or after the vernal equinox, the ensuing summer is generally *dry*, at least five times in six.

2. That when a storm happens from any easterly point, either on the 19th, 20th, or 21st of March, the succeeding summer is generally *dry* four times in five.

3. That when a storm arises on the 25th, 26th, or 27th of March, and not before, in any point, the succeeding summer is generally *dry*, four times in five.

4. If there be a storm at S.W., or W.S.W., on the 19th, 20th, 21st, or 22d of March, the succeeding summer is generally *wet*, four times in five.

To the above we shall add the following observations from the Encyclopedia Britannica.

1. A moist autumn with a mild winter, is generally followed by a cold and dry spring, which greatly retards vegetation.

2. If the summer be remarkably rainy, it is probable that the ensuing winter will be severe; for the unusual evaporation will have carried off the heat of the earth. Wet summers are generally attended with an unusual quantity of seed on the white thorn and dog-rose bushes. Hence the unusual fruitfulness of these shrubs is a sign of a severe winter.

3. The appearance of cranes, and birds of passage, early in autumn announces a very severe winter; for it is a sign that it has already begun in the northern countries.

4. When it rains plentifully in May, it will rain but little in September, and vice versa.

5. When the wind is S.W. during summer or autumn, and the temperature of the air unusually cold for the season, both to the feeling and the thermometer, with a low barometer, much rain is to be expected.

6. Violent temperatures, as storms or great rains, produce a sort of crisis in the atmosphere, which produces a constant temperature, good or bad for some months.

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"Ah! who can tell the triumphs of the mind,
By truth illumin'd, and by taste refin'd."—*Rogers.*

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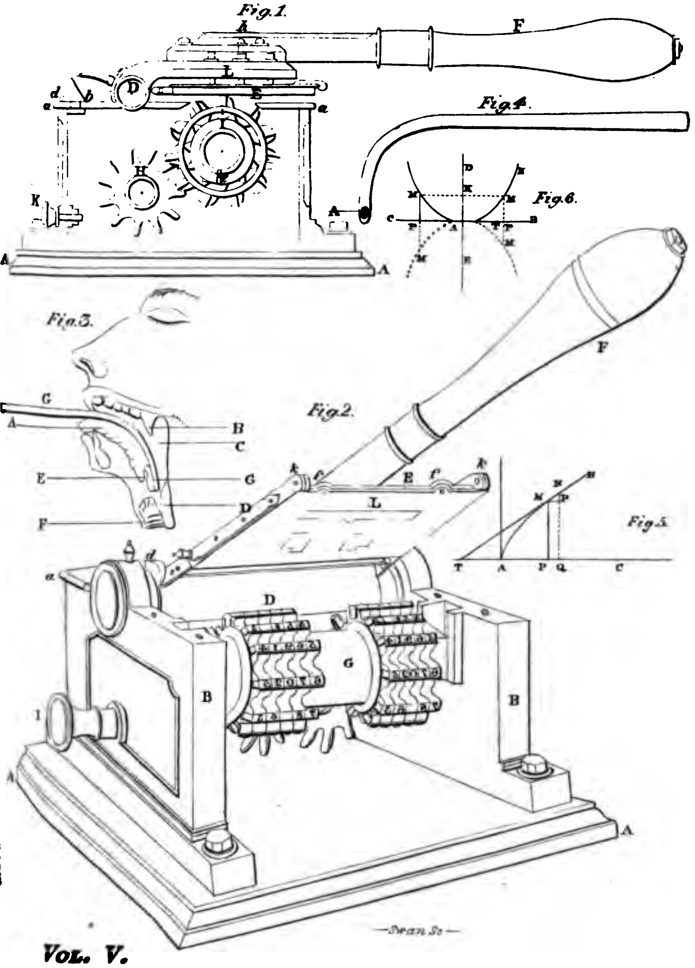
BRAMAH'S MACHINE, OR PRESS FOR PRINTING BANK NOTES; &c. &c.



BRAMAH'S MACHINE, OR PRESS FOR PRINTING BANK NOTES.

The numerous valuable and ingenious inventions of Mr. Bramah are already too well known to the public of this country, and their advantages have been too long experienced by society, to require that we should pass any eulogium either on the abilities of the inventor, or the usefulness of his inventions. It would indeed require a volume to give even an account of the whole that he has done. We have already described some of them in our work, and will, from time to time, introduce some others, as we proceed. His improvements upon locks; his rotatory engine for raising water; his hydrostatic press, applied to cranes, and to the sluices of canals; his improvement on the steam engine; his planing machine, for producing parallel surfaces on wood; his method of cutting screws and turning spheres; his equalising tool, or apparatus for turning cylinders at one operation; his method of introducing steam into the upper coppers of breweries; his contrivance for locking carriages; his improved pens, by which no part of the quill is lost; and his new plug and sliding cocks, are all well worthy of being noticed, and would be described by us, did our limits permit. We, on the present occasion, lay before our readers, the following account of his Press for printing Bank Notes.

It was formerly the custom in the Bank of England to fill up the numbers and dates of their notes in writing, till the year 1809, when the machine invented by Mr. Bramah was adopted for this purpose. By this contrivance, the numbers and dates were inserted not only in a more uniform and elegant manner, but the labour was diminished to less than one sixth of what it was before.

The copperplates, from which the words of the notes are printed, are double; that is, they throw off two notes at a time upon one long piece of paper. This piece of paper, containing two notes, is then put into the machine, which prints upon them the number and dates in such a manner, that the types change to the succeeding number, and that the whole operation is performed without any attention on the part of the clerk. If one of the notes, for example, is No. 1, No. 1, and the other on the same paper No. 201, No. 201, when these are printed, the machine alters itself to No. 2, No. 2, and No. 202, No. 202; and in printing these, the types again change to No. 3, No. 3, and 203, 203. The date, and the word London, are cast in stereotype, and each machine is furnished with one of these for each day in the year, and they of course are changed every day.

The Bank of England have upwards of 40 of these machines, the greater part of which are in constant use. It was formerly considered sufficient labour for each clerk to fill up with the number twice repeated, and date twice repeated, 400 notes per day; but since the introduction of the machines, one clerk has printed 1300 double notes, which are equal to 2600 single ones; for though in the machine the double notes do not require more labour than single ones, yet to fill up the blanks by writing, would occupy twice the time.

The mechanism by which this is effected is extremely ingenious, and the principle is not limited to the numbering of notes, but is equally applicable to the purpose of printing any series of numbers which require continual alteration. In this Plate we have represented one of these machines, which is not, however, precisely the same as any of those in use, being only a single one, and adapted for printing one note at once; but we have only to suppose it extended to twice the length, and furnished with a double set of types, in order to fit it for printing two notes at the same time. In fig. 2. of the plate, a perspective view of this machine will be found, and a section of its parts at fig. 1. in both of which the same letters of reference are employed. A solid piece of mahogany, A A, forms the base of the machine, and to this two iron plates B B are screwed, forming the sides of a box, the front of which is removed in fig. 2. to exhibit the interior, and the back is concealed behind the mechanism. Across this box, an axis D is placed, having its pivots fitted into sockets, which are fastened in the sides of the frame, as is evident from the figure. This axis carries the tympan E, which gives the pressure to print off the note attached to it by screws, and a lever F is also fixed to the axis, by which the operator forces down the tympan. The moveable types, in which the principal novelty of the invention consists, are fitted into a series of brass circles, mounted upon an axis G, extending across the centre of the frame. These circles are sufficiently pointed out in the perspective view, by the numerals on the types fixed in them; they are ten in number, arranged in two lots of five each. Each circle (shewn more plainly at 1, fig. I.) is divided into 11 parts, and at each a rectangular notch is cut to receive the types 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, and a blank type. Five of the circles, thus prepared, being placed side by side, upon a fixed axis, G, on which they revolve freely, are sufficient for printing any number less than 100,000; because, as the circles can be turned about on their axis independant of each other, it is obvious, that any combination of the above figures may be produced, by bringing them to the highest point of the circle, which is the situation in which they are placed when an impression is to be taken. This will be more easily understood, if we consider that the brass plate, which covers up the circles, is put in its place, as represented in fig. 1. at *a*. This brass plate has two apertures through it, to receive the two series of types which project up a little above its surface when at the highest. In fig. 2. this plate is removed, to exhibit the interior mechanism. The circles are made to revolve by means of wheels H, upon an axis, called the back axis, parallel to the axis of the circles. The end of it is seen at I, fig. 2. projecting through the frame, and it carries three of the wheels H, two of which are at the same distance, apart as the two series of figure circles to which they apply. The third wheel is placed at an intermediate distance between the other two, and is acted upon by a catch or pallet *b*, fig. 1. attached to the axis of the tympan, by means of a joint, in such a manner, that it will strike against the highest tooth of the wheel H, and turn it round one tooth. When the handle is lifted up rather beyond the perpendicular, where a stop *d*, fig. 2. upon the axis, meeting a projection *d*, fig. 1. on the cover of the box, prevents it from moving farther; but when the handle is returned down into the position of fig. 1. the pallet, though it again meets the tooth of the wheel, gives way upon its joint, and passes by without moving the wheel. In this manner, it will be seen, that every time the handle is pressed down to take an impression, in raising it up again, to place a fresh paper upon the tympan, the pallet moves the wheels H one tooth, and as the teeth of these wheels engage the teeth of the figure circles, a similar motion is communicated to them, bringing a fresh number beneath the tympan, ready for printing.

It is to be observed, that the wheels H are of such a thickness, as to engage only one of the five type circles at once, and their distance from each other is such, that they take the same circle in the one series as they do in the other. Now, by moving the back axis a small quantity endwise, it is obvious that the wheel H can be brought to act upon any of the five circles, or be placed in such a position as to be clear of them all. It is for this purpose that the head I, fig. 2. comes through the frame of the machine; for by means of this the axis can be moved on end, and by proper marks upon it, it may be set to any of the five circles. In these positions it is confined by a semicircular clip, which enters grooves turned round on the axis, and deprives it of longitudinal motion, unless when the clip is raised. This can be done by a nut coming through the back of the frame at K, Fig. 1. It has a short lever on the inside of it, which, when the nut is turned round, raises up the clip, and releases the axis while it is set to the required circle, and the clip being let fall into the proper groove, confines it from any farther motion. In order that all the circles may stop at the exact point, when the figure is at the highest, and consequently when the surface of the figure will be horizontal, an angular notch is made on the inside of the figure circles, in the intermediate spaces between each figure, and at the lowest point of the circle *e*, fig. 1, a moveable pin is fitted into the fixed axis, with a spring, which gives it a constant pressure downwards. The end of the pin is formed spherical, and well polished, so that when the circle is turned round, it is forced into its hole in the axis; but when another notch in the circle presents itself, the pin presses out into it, and retains the circle with a moderate force in its proper position, until the raising of the tympan, as before described, overcomes the resistance of the pin, and turns the circle round. By this contrivance, the types always arrange themselves into a straight line, after being turned round, without which the impression would have a very disagreeable and irregular appearance. The tympan E, fig. 1, is composed of two parts: a solid brass plate, against which a few folds of cloth are placed and secured by the second part, which is a brass frame, covered with parchment, and attached to the former by four screws, two of which appear at *f f* in fig. 2. The brass plate of the tympan is fastened to the leaf L, fig. 1, projecting from the axis by means of six screws. Two of these, only one of which, *h*, can be seen in the figure, tend to throw the tympan from the leaf, while the other four, which are arranged one on each side of the two former, draw the tympanum and leaf together. By means of these screws thus acting in opposition, the tympan can be adjusted so as to fall exactly parallel upon the type, and communicate an equal pressure to all parts of the paper, which is held against the tympan, by means of a frisket of parchment, stretched on a frame which surrounds the tympan, and is moveable on joints at *k*, *k*, fig. 2. The frisket is cut through, as represented by the shaded parts in fig.

2, in order to expose the paper where it is to receive the impression of the figures, and the N° before the figures, and also the impression of the date, year, and place. The types for these are formed in stereotype, and fastened down upon the surface of the brass cover *a*, the piece containing the day and month being changed every day. In order to find the proper position which the paper should occupy upon the tympan, two fine pins are fixed to project from it, and are received into holes made in the brass cover: Two dots are printed upon the note from the copper plates, and the pins being put through at these dots ensures the figures, &c. coming on their proper places.

The manner of using the machine is as follows: Suppose the back axis put so far on end as to be detached from all the circles; the figure circle arranged by hand, so that the blanks are all uppermost; and the proper stereotypes put in for the date. The back axis is then first set, so that its wheels H may take the first of the five circles towards the right hand, and, by moving the handle down almost to touch the type, and returning it up again the pallet moves the wheels H, and turns the two right hand circles, bringing up figure 1. The clerk now inks the type with a printer's ball, opens the frisket sheet L, fig. 2, on its hinges, and places the note, (already printed in the copper-plate press,) against the tympan, the proper place being determined by the two pins and the dots printed on the note, as before mentioned. He now shuts up the frisket sheet, in order to confine the paper and to keep it clean, except in the places where it is to be printed; then, by pressing down the handle F, the impression is given; and on lifting it up again, it moves the circles, and brings up fig. 2. The note is now removed, a fresh one put in, and so on, the figure always changing every time. During this operation, the two right hand circles act as units, and advance one each time. When 9 are printed in this manner, and 0 comes up, the handle is moved twice successively without printing, which brings up a blank and then 1. The back axis is moved, to act upon the second circle on the right hand, which now becomes the units, the first circles representing tens; by moving the handle *a*, without printing, figure 1, in the second circle comes up, making 11, the next time 12, and so on to 19. The first circle is now put forwards by hand, bringing up 2 and 0, on the second 20, then moving the handle to pass the blank, produces 21, 22, &c. to 30, when the first circle is again advanced, bringing up 4; in this manner the business proceeds to 99. The back axis is now shifted to the third circle, which becomes units, the second tens, and the first hundreds; the 0 and blanks of which are advanced to bring up 1, 0 is brought up in the second; and the machine itself brings up 0 in the third; after printing this, it changes to 101. The process now continues through the successive hundreds in the same manner as before, till 999. The back axis is now shifted to the fourth circle, and the three first must be advanced by hand when they require it. At 9999 the back axis is shifted to the fifth circle, and will serve to 999,999, beyond which it is not required to print.

REMARKS ON THE MEANS OF RECOVERING LIFE AFTER IMMERSION IN WATER.

By William Mackenzie,

Andersonian Professor of Anatomy and Surgery, and one of the Surgeons to the Glasgow Eye Infirmary.

Gentlemen,—Although the following remarks have in part been laid before the public already, yet the numerous and fatal accidents which are daily reported in the public papers, urge me to beg a place for them, in your extensively circulated miscellany.

In relating the very numerous instances of loss of life from drowning, it is frequently mentioned that "*the body was conveyed to a neighbouring house*," or "*to a surgeon's shop*," and that "*every means used for the restoration of life proved ineffectual*." It occurs to me that the very conveyance mentioned is often the cause of the want of success; and that, were the proper means instantly to be had recourse to on taking the body out of the water, recovery would be much more likely to follow.

Accidents of this kind always come unexpectedly—they come with a loud demand upon every passer-by to assist in the recalling of the spark of life; but as it is supposed by most people that the treatment of such a case requires something very difficult to be done, this demand is unfortunately too often made in vain.

It is now generally known that the delicately-sensible chink of the windpipe shuts completely against the admission of water into the lungs. The person dies, not so much because he is in the water, as because he is not in the air—he dies, not because he is filled with water, as the vulgar once supposed, but because he has been deprived of the atmospheric fluid.

Almost immediately on being immersed, the person first of all expells a portion of air from his lungs, in consequence of the instinctive necessity of a partial renewal of the quantity which is already there: he next makes an attempt to inspire—but a natural inspiration it is impossible for him to make in his present circumstances; the consequence of his attempt at inspiration is that the water rushes into his mouth and nostrils; but against that foreign fluid the chink of the windpipe shuts with instantaneous convulsion. The demand for renewed air by the lungs is now repeated—the air in the lungs is still more unfit by this time for purifying the blood which is there waiting for the performance of that process; an effort is again made by the person to expire a quantity of that air, this empties the lungs still farther, and now another attempt is made to inspire, but in vain. A repeated expiration, and a repeated attempt at an inspiration which is impossible, constitute the process of exhaustion. A very few repetitions of this process take place, the blood rests unpurified, the person drops, and but too often drops never to be re-animated.

There is a striking resemblance between the state of a body in which respiration has been thus suspended, and the state of a child before respiration has ever commenced. In both cases the lungs are collapsed; in the fœtus no doubt much more than in the adult, yet the analogy is striking: the more so, that, in order to restore life in the one case, we must produce exactly the same train of changes by which respiration was first established, and an independent life first called into play in the other. We must remove the collapsed state of the lungs; we must furnish them with that fluid by which alone they can effect the necessary change on the accumulated blood which they already contain. A little venous blood has already run, no doubt, through the heart and into the arteries; and it is probably this very cause which sometimes renders re-animation impossible, even after the lungs are dilated; for the venous blood is the most deadly poison to those parts which were wont to be touched only by arterial blood. But the important fact is, that the vessels of the lungs are now turgid with venous blood, and that this one process only is capable of driving it through them—*the expansion of the cells of the lungs by air.*

This, in his present state, the person cannot do for himself, and some one must do it for him. There is still a degree of irritability lingering in the lungs, and in the blood-vessels which ramify through them—but it is a very fleeting irritability. There is no time to go in search of bellows, by introducing which into one of the nostrils the lungs might be inflated—or of any flexible tube, such as a gum-elastic catheter, which might be bent through the mouth, or through the nose, into the chink of the windpipe—a contrivance which, if employed within a certain time, for inflating the lungs, would generally secure the return of life. The man is dragged up on the bank of the water, and what we can do must be done now or done never. Close his mouth, press back the top of his windpipe that the air may not run *down through his gullet* merely into his stomach, put your mouth to his nostrils, and blow with force and for some time. This, I conceive, is what we have to do, and what we ought to repeat; and if this do not succeed in exciting first of all a convulsive sob, and then a gradual and difficult renewal of respiration, I am afraid that no other means will succeed.

We may have no assistant—we may be alone, with the seemingly dead person stretched out before us—and as this seeming death may in a few minutes end in real death, we must instantly have recourse to the chief means for re-animation. I have no hesitation in saying that that means is *Inflation of the Lungs.* If luckily any bent or flexible tube be at hand, such as a catheter, it is to be introduced into the windpipe, as is represented in fig. 3 of the plate. The left fore-finger being carried backwards and downwards over the tongue, the epiglottis E will be felt, close behind which the tube is to be introduced and pushed down into the windpipe for an inch or an inch and a half. Then through the tube air is to be blown.

If we have the assistance of another person or of several others, they ought not to be idle. Let one of them, kneeling down behind the inanimate person, endeavour to make the chest imitate the alternate enlargement and diminution which it undergoes in natural inspiration and expiration—laying hold of the ribs on each side, and endeavouring first of all to raise them and dilate the chest at the moment when the chief operator is blowing into the nostrils or through the tube, and then allowing the ribs to descend, pressing them at the same time inwards, and pressing the belly back. These things our first assistant must continue, so long as we continue our attempts directly to fill the cells of the lungs with air.

The other assistants, if others there happen to be, may dry and warm the body—and if opportunity serves, a glister of warm wine may be administered;—but let nothing interfere with the attempt to RESTORE RESPIRATION.

I should never spend time in conveying the body to a house—nor should I set about drawing blood from the person's arm—nor should I be very anxious about restoring to him his natural warmth. The time which might be occupied in re-exciting respiration, which, if re-excited, will restore not only heat but life, ought not to be taken up in any thing of inferior importance.

To read the directions which are published for the treatment of such cases, one might suppose deliberation and decorum as necessary as promptitude and effectual interference. We are told first of all to strip the body, to dry it well, and wrap it in the warm clothes of some by-stander; and after it has arrived at the house, where we are to follow out our attempts towards resuscitation, we are directed to lay it on a mattress, or on a double blanket spread upon a table, in a room where there is a fire. But in doing all this, we must take the utmost care that any degree of friction employed be of so gentle a kind as not to propel the blood towards the already distended heart.

Now, in place of all these, and many other long-winded directions, I would simply say, INFLATE THE LUNGS.

The same method is to be followed in cases of suffocation by foul air—only let it be carefully recollected, that in such cases it has been found one of the best restoratives to dash cold water in pailfuls over the surface of the body.

Spreull's Court, 22d June, 1826.

Description of the Plate.

Fig. 3.—A the tongue; B the avula, or pap of the hass; C the pharynx, or wide part of the gullet; D the œsophagus or narrow tubular part of the gullet leading to the stomach; E the epiglottis; F the windpipe; G G the tube introduced into the windpipe.

Fig. 4. shews the proper bend of a tube for inflating the lungs. It may be made of silver, pewter, or copper. The slender extremity, which is to be passed into the chink of the windpipe, is rounded off for more easy introduction, and furnished with an opening on each side (A) the two openings being exactly opposite to each other.

ON THE DIFFERENT FORMS OF THE PARABOLA.

LET there be a line of which the extremity A is given, but which may be unlimited towards C, and let there be a curve A M B, such, that a right line drawn from any point, P in the curve, at a given angle, has a relation to the abscissa expressed by the equation $y^3=a^2 x$, (a denoting a given line) the curve is the common parabola. But if the nature of the curve be expressed by this equation, $y^3=a^2 x$ or $y^3=a x^2$, it is called a cubical parabola. In the same manner, if we have the equation $y^4=a^3 x$ or $y^4=a x^3$ the curve will be a parabola of the fourth order, and so on to infinity.

If for the numerical exponants of the variables x and y, we substitute the letters m and n, we get a general equation for all kinds of parabolas, namely, $y^n = x^m a^{n-m}$, and abbreviating, by making $a = 1$ we have $y^n = x^m$, which expresses the nature of all kinds of parabolas.

Let two indefinite straight lines B C, D E fig. 5, cut each other in the point A, and let there be a parabola A M of any degree in the angle D A B. From any point M, draw M P parallel to D E. Call M $P = y$, A $D = x$, and the given quantity $a = 1$, we have always from the nature of the curve $x^m = y^n$, (m and n denoting any positive whole number, and m greater than n,) from which it follows, that when $x = o$, $y = o$, likewise; the more n increases the more will y also increase. It remains to be proved, that the subtangent P T is always less than x.

A general expression for the subtangent (S) of all parabolas, in terms of the exponants m and n, and of the indeterminate quantity x, may easily be obtained from the general equation $y^n = x^m a^{n-m}$, or if $a = 1$, $y^n = x^m$ of all parabolas. Let the arc M N be indefinitely small, draw N Q parallel to P M, and M R parallel to A C: the triangle M R N, T P M are similar, as the small arc M N may be considered as part of the tangent T M. Let P Q or M $R = e$, then we shall have from similar triangles T P M, M R N, R $N = \frac{e y}{S}$.

Now substitute the two first terms of the power n of $y + \frac{e y}{S}$, or $(y + \frac{e y}{S})^n = y^n + \frac{n e y^n}{S}$ for y^n in the general equation $y^n = x^m$; and the two first terms of the power m $x + e$, that is, $x^m + m e x^{m-1}$. And subtracting the first equation from this, and dividing afterwards by e, we shall have $\frac{n y^2}{S} = m x^{m-1}$; and therefore $S = \frac{n y n}{m x m-1}$; and putting x^m for y^n, $\frac{n}{m} x =$ P T, n being less than m, $\frac{n}{m} x$, must therefore be less than x. Whence it follows that the parabola shall always pass through the point A: (fig. 6,) that it will recede more and more from the line B C, and that the curve is convex towards the diameter. But the curve A M, in the angle D A B, is only a portion of the parabola, in which of the other three angles D A C, C A E, E A B, will the remainder of the curve be found.

Suppose m the exponant of x an even number, and n the exponant of y an odd number. The mth root of x^m shall be $+ x$, and the nth root of y^n shall be only $+ y$; for if $m = 4$, and $n = 3$, then it is plain that the fourth power of $+ x$ is always x^4, but the case is different with the cube of $+ y$, since the cube of $\times y$ is y^3, and the cube of $-y$ is $-y^3$. Hence x may be both positive and negative, but y is always positive. Consequently the parabola A M, must be continued in the angle D A C, so that if a right line be drawn through any point, K of the line A D parallel to B C, the same shall meet the parabola M A M in two points M M, equally distant from the point K. And this is the common parabola or the loans of the equation $n^2 = a\ y$, or $n^2 = y$ if the paramiter $a = 1$.

Let the indices of m and n both be odd numbers. The m^{th} root of n shall be only $+ x$, and the n^{th} root of y^n only $+ y$; but because the equation $x^m = -y^n$ is the same as $x = y^n$, and the m^{th} root of $-x^m$ is $-x$, and the n^{th} root of $-y$ is $-y$; therefore x may be both positive and negative; and the same of y, observing that when x is positive y is so also; and the contrary. From which it appears that the parabola A M must be continued in the angle C A E, vertically opposite to D A B in a position altogether the same as in the angle D A B, but inverted: so that A P being taken equal to A P, and P M making the angle A P M = angle A P M; the right line P M meets the portion A M, falling in the angle C A E in the point M, such that P M is equal to P M. And this is the cubical parabola $x^3 = a^2 y$.

If m is an odd number, and n an even number: the m^{th} root of x^m shall always be + x and the n^{th} root of y^n shall be + y. For let A M be a cubical parabola which is the locus of the equation $n^3 = a y^2$ or $n^3 = y^2$, it is plain that the cube root of $x^3 =$ is only + n, but the cube root of y is + y. Therefore the parabola A M must be continued in the angle B A E, adjacent to the angle B A D, so that if a line be drawn through any point, P of the line A B parallel to D E, it shall meet the whole parabola in two points, M M equally distinct from the point P.

Now the general equation $x^m = y^n$ always belongs to one of these three cases. For if m and n are both even numbers, by extracting the square root of both sides of the equation as often as possible, it shall be reduced to an equation wherein one of the indices must be odd. And m may be supposed always greater than n. From which it follows, that parabolas of whatever degree must have one or other of these three forms.

The curve A M N is first continued through angle D A C. 2dly, through C A E marked by the dotted line, and lastly, through E A B marked by the crossed line.

MECHANISM.

In order to constitute any matter mechanism, it must bear evidence, first, of intelligence; secondly, of design; and, lastly, of a designer. Intelligence is that faculty of the mind by which we are enabled to understand, to judge, and to determine; to contrive, and to execute. Contrivance, a design, has its origin in, and emanates from intelligence. Mechanism is the production of design, the execution, or work of a designer.

To determine what is properly mechanism, and what is not, may require more investigation in some cases than in others; but we are disposed to believe, that mechanism is more or less exhibited in every class or species of existence, animate or inanimate. All nature, even *the most apparently* insignificant object, evinces proofs of mechanism, of contrivance, proofs of an intelligent and designing mind; forcing conviction upon the Atheist; filling with admiration and wonder the most callous, and obdurate heart. The invincible truth, that no matter can exist itself, pre-supposes, in despite of every perversion of human intellect, a designer, capable of thinking, and of acting.

We are in the habit, generally, of associating our ideas of mechanism, with what is merely of human invention. That which pertaineth to the earth, we denominate *nature*, that which is of man we pronounce *art*. The genuine import of the term, however, we are inclined to think, may extend to both. Every thing is mechanical in so far as it exhibits works of contrivance. Now, in respect to a watch, or any thing else of human construction, we, by the simple exercise of our visual organs, can easily discover that it is composed of parts, we can discover too that these parts are all fitted and adapted to one another, that this connection of parts constitutes a whole, and are so harmonized and fitted to one another, as to accomplish a certain purpose. Again, by the simple exercise of the faculty of reason, we can discover, that these could not of themselves go together, but have been so formed, and set by some intelligence:—Contrivance is apparent in the very structure of the machine, as well as in the end for which its parts were arranged, and which such arrangement is the evident means of accomplishing. In respect to what we term the natural world, the same reasoning applies. No matter can form, or exist of itself; neither can any constitution of matter give evidence of inherent intelligence, or self-formation.—*Curiosus.*

ON MECHANIC SCHOOLS AND ON POLITICAL ECONOMY AS A BRANCH OF POPULAR EDUCATION.

By Thomas Chalmers, D, D.

(Concluded from page 268.)

After having discussed the causes which influence wages, the explanation of those causes which influence profits, would lead to another, and a most interesting branch of a popular course. And here it must be obvious, how easy it were, on the strength of a few plain and intelligible simplicities, to infuse, even into the hearts of workmen, a spirit of candour and of conciliation towards their employers. More particularly, could they be made to apprehend, how impossible it is, in a state of freedom, for profits to subsist, during any length of time, at a higher rate than they ought to do. When profits are high, capital accumulates; and when capital is accumulated, profits fall. Again, when, in virtue of some accidental influence, profits are very unequal, so as to be unreasonably high in one trade, there is, in a state of liberty, a rush of capital from all other trades, so as to bring all down to a general level. In this increase of capital, and competition of capitalists, labourers will *at length be made to* perceive that their security lies; and that, if they will only so far respect themselves, as that their high standard of enjoyment shall have the influence already explained, in restraining the increase of population, a high wage for work will be the inevitable consequence; and such a wage, as is alike independent, either of illegal enactments, or of illegal combinations. It would have been greatly more satisfying to us, had the legislature not felt it necessary to assume even the semblance of hostility to the working classes. Certain it is, that no real hostility is felt; and that, even if it were, it would be wholly ineffectual. It could not depress the wages of labour a single farthing beneath the rate at which it would have settled, in virtue of those economic laws over which the government of a country has no control. Even though it were death by the law, for one labourer so much as to talk of wages to another; and though a universal espionage were to make the law as operative as it is barbarous; yet this could not bear down the elevating power upo wages, which lies in an accumulating capital upon the one hand, when it meets, upon the other, with a population restrained within right limits, by the prudential and moral habits of the individuals who compose it. The law against combinations is a *telum imbelle,* if its object be to depress wages; and it is only desirable, that workmen should be so far enlightened as to perceive this. Then would they leave it to repose in its own inefficiency; and, instead of going forth to the battle, either against their rulers or their employers, they would learn, that the sure road to victory was, for each quietly to betake himself to the virtues and the frugalities of private life.

It is thus that, without any effort, certainly without any combined effort, and without even their looking for it, there may, purely by a change of general habit, on the part of our workmen, be a gradual, but sure elevation, in the price of their labour. Capitalists cannot, though they would, long realize an extravagant profit at the expense of wages. The same competition among labourers which brings down wages, operates also among capitalists, to bring down profit. What labourers have to do, is, to slacken the former competition, by keeping down the supply of labourers, and leave the latter competition to operate. Let them but restrain the increase of population, and then make their harvest of the increase of capital. Masters, however willing, have it not in their power to realize, for any time, an excess of profits to the prejudice of the servants; for excess of profit gives rise to the exuberance of capital, and so to a keener competition for more labourers. Other capitalists will plant themselves in their neighbourhood, and, either by outbidding, wrest from them their workmen, or force them to give a higher wage than before. There is no organization of labourers required to bring about this result—nothing, in fact, but that higher style of comfort and decency, which it is the effect both of Christian and common education to spread over the land. The foolish but impotent outbreakings of the last year will end in no permanent result whatever. A busy process of moral and mental culture, would, in a very few years, tell, and permanently tell, on the condition of our general peasantry. The market is overstocked with capital. Let not the advantages of this to the working classes be neutralized, by the market being also overstocked with labour. Then, instead of men seeking after masters, we shall have masters seeking after men. Instead of workmen underselling their labour, we shall have capitalists overbidding for it. For this blissful consummation, workmen do not need to step abroad and form themselves into grotesque committees, and frame laborious articles, and make their cunning inventions of sign and countersign. They will gain nothing by all this, so long as they suffer themselves to be oppressed by the weight of their own numbers. It is this, and not the tyranny of their masters, which oppresses them. Let them but relieve themselves of this, and they will carry their point without all that curious machinery of councils, and correspondence, and deputations, in which heretofore they have vainly imagined that their strength lay. They would not need, in fact, to call upon masters; for masters, overcharged with capital, and desirous of extending their works beyond the supply of workmen, would call upon them. Instead of turbulently meeting in the hall, or in the field, each might stay quietly at home, and at his own business; and the day of a coming enlargement to our labourers will not come one whit later, though they should leave the expedient of a combination for ever untried. There is no other way in which the tables can be turned between them and their masters; so that instead of workmen begging from capitalists for their employment, capitalists shall go a-begging among workmen for their services. This we should rejoice in, as a consummation devoutly to be wished. It were a great economic revolution brought about by the peaceful operation of moral instruments. Labourers would share more equally with landholders and traders than before: insomuch, as wages would bear a higher proportion, both to rent and to profit. The social fabric would still have its orders, and its gradations, and its blazing pinnacles. But it would present a more elevated basis. At least the ground floor would be higher, while, in the augmented worth and respectability of the people, it would have a far deeper and surer foundation.

One great object of a wisely conducted economic school, whose presiding spirit would be that of loyalty to the state, and love to the population, were to labour well the proposition, that it is not in the power of master manufacturers to realize, for any length of time, any undue advantage over their workmen. And here it might be well to expound the relation which there is between the profit of capital, and the interest of money, after which the fall of interest might be alleged as affording patent exhibition of the universal decline that has taken place in profits. This would lead to some other cause for any depression in the wages of operatives, than the extravagant gains of their employers; and would enable even the homeliest of the disciples to perceive, that they are deprived of the advantage which they might have gotten from the competition of a now greatly increased capital, just because it was outdone by the stronger competition of a still more greatly increased population. In other words, that it was an advantage of which the population had deprived themselves. At all events, the capitalists are quite innocent. They cannot help themselves as the labourers can. It is well for the spread of peace and charity among the working classes, that they should be delivered from the false imaginations that their masters are their oppressors. And it is further well for the spread among them of virtuous, and temperate, and elevated habits, that they should be thoroughly possessed with the true doctrine of wages; that they are themselves their own deadliest oppressors; and that, without the co-operation of their own moral endeavours, no benevolence on the part of the affluent, and no paternal kindness or care on the part of their rulers, can raise them from the degradation into which a reckless or unprincipled peasantry shall have fallen.

It is needless, at present, to inquire how much farther mechanics could be raised, in the scale of doctrine and information, on the subject of economical science. This would better be ascertained afterwards. But we are thoroughly persuaded, that the few elementary truths, along with their obvious and popular applications which we have now specified, could not only be received by the popular understanding, but would go far to dissipate all those crudities of imagination which excite the fiercest passions of the vulgar, and are, in fact, the chief elements of every popular effervescence. To make the multitude rational, we have only to treat them as if they were fit subjects for being discoursed with rationally. Now this, in reference to the great topics of misunderstanding between them and their employers, has scarcely ever yet been done; and the experiment remainsto be made, of holding conference with the people on the great principles of that economic relation in which they stand to the other orders of society. We anticipate nothing from such a process, but a milder and a more manageable community; and feel confident, that the frankest explanations of the mechanic teacher would be received by his scholars in the spirit of kindness. He may be in no dread of the utmost explicitness, or lest those truths which bear severely either upon the sordidness or the violence of the people, should fall unwelcomely upon their ears. They will bear to be told both of the worthlessness of pauperism, and the gross injustice of those workmen who would infringe on the liberty of their fellows. Even those truths which go to vindicate their masters, and which look hardly or reproachfully upon the operatives, ought, in no way, to be withheld from them. We affirm, that reason will make any thing palatable to the lower orders; and, if only permitted to lift her voice in some cool place, as in the class-room of a school of arts, she will attain as firm authority over the popular mind, as she wields now within the walls of parliament. And political economy, the introduction of which into our popular courses has been so much deprecated, will be found to have pre-eminence over the other sciences, in acting as a sedative, and not as a stimulant to all sorts of turbulence and disorder. It will afford another example of the affinity which subsists between the cause of popular education, and that of public tranquillity. Of all the branches of that education, there is none which will contribute more to the quiescence of the multitude, than the one for whose admittance into our mechanic schools we are now pleading. They will learn from it, what be the difficulties by which the condition of the working classes is straitened, and how impossible it is to obtain enlargement therefrom, while they labour under a redundancy of numbers. It will at least help to appease their discontent, when given to understand, that with this redundancy, any solid or stable amelioration of their circumstances is impracticable; and that, without this redundancy, the amelioration would follow of itself, and that, to bring this about, the countenance of legislators, and the combination of labourers, were alike unnecessary. The lessons of such an institution would be all on the side of sobriety and good order. They would at length see, that for the sufficiency of their own state themselves were alone responsible, and after bidding adieu to all their restlessness, they would be finally shut up to that way of peace and of prudence, by which, and by no other, they can reach a secure independence.

MISCELLANIES.

Stereotype Printing.—Senefelder, to whom the world isindebted for the invention of lithography, has discovered a new method of stereotyping, which is thus effected. A sheet of common printing paper is covered with a coat of stony earth half a line in thickness, which is moistened with a sufficient quantity of water; at the end of half an hour this assumes the consistency of paste, and is then spread in the frames over the characters, which are arranged as usual, but not blackened, and which are thus impressed upon the paste. The sheets are then dried upon a stone slab and covered with melted metal; the writing then appears in relief upon a thin plate of metal, and exactly formed upon the original letters. The copies taken from these stereotyped characters do not differ from what are obtained by the ordinary process. The invention will not be made public till the author has obtained a subscription of 100 florins each from thirty subscribers. The expense of the apparatus necessary for the casting, he estimates at 100 florins, or L. 11. 3s. 7-824d. and that of the paper, covered with the stony paste, at six kreutzers, or 2.676 pence per sheet.

Strength of Men.—The strength of savages has frequently been represented as far superior to that of men in a state of civilization: towards the end of the last century an ingenious instrument to which he gave the name of dynamometer, was invented by M. Reginer of Semur, for determining with precision both human power and that of machinery. This was employed by Peron in his voyage to New Holland, and this able navigator has shewn that the strength of savages is uniformly less than that of civilized men.

Electro-Chemical Metal Preservers.—In a paper by H. Davy in the last part of the Philosophical Transactions, it is mentioned that, independently of the chemical, there is a mechanical wear of the copper in sailing, which on the most exposed part of the ship, and in the most rapid course, bears a relation to it, of nearly 2 to 4.55. As the result of actual experiment, as to the electro-chemical means of preserving the copper sheathing of vessels, the President is led to conclude, that the proportion of protecting metal should be from 1-90th to 1-70th; that the most advantageous way of applying protection, will be under and over the copper; the electrical circuit being made in the sea-water passing through the places of junction in the sheets; and in this way every sheet of copper may be provided with mails of iron, or zinc for protecting them to any extent required. By driving the nail into the wood, through paper wetted with brine above the tarred paper or felt, or any other substance that may be employed, the incipient action will be dimnished; and there is this great advantage, that a considerable part of the metal will, if the protectors be placed in the centre of the sheet, be deposited and redissolved, so there is reason to believe, that small masses of metal will act for a great length of time. Zinc, in consequence of its forming little or no insoluble compound in brine or sea-water will be preferable to iron for this purpose; and whether this metal or iron be used, the waste will be much less than if the metal were exposed on the outside, and all difficulties with respect to a proper situation in this last case are avoided. The copper used for sheathing should be the purest that can be obtained, and in being applied to the ship its surface should be preserved as smooth and equable as possible; and the nails used for fastening should likewise be of pure copper, and a little difference in their thickness and shape will easily compensate their want of hardness. In vessels employed for steam navigation the protecting metal can scarcely be in excess, as the rapid motions of these ships prevents the chance of any adhesions; and the wear of the copper by proper protection is distinguished more than two-thirds.

African Expedition.—Letters have been received from Captains Clapperton and Pearce, dated Badagry, in the Bight of Benin, 29th November. A merchant there, of the name of Houston, was to proceed with them, in palanquins, through the King of Badagry's territories (about 125 miles), and into those of the King of Hio. Beyond Hio is Nyffe of Nyffoo, to which the route lies through Tassa, and these places are represented to lie—Tassa about 225 miles from Hio, and Nyffe as much from Tassa. Nyffe is to the south of Bello's dominion's, and his capital Sackatoo. It is stated that no obstacles are feared after reaching Hio. At Whydah our our countrymen had met a de Sonza, a Portuguese, and also Mr. James, who is so much spoken of in Bowdich's Travels: both these persons recommended them to proceed to Dahomey, and to visit the king of that country at his capital Abomey. Later accounts mention the death of Captain Pearce and others of the expedition.

Magnetism.—Professor Hansteen, who has paid much attention to the phenomena of magnetism, having observed that there are natural magnets having four poles, two and two of the same denomination, inquires if the earth itself be not such an anomalous magnet; and proposes the two following questions: "Are two magnet poles sufficient to explain all the phenomena of the declination, or must we assume several of them?—What is the position and motion of these poles?" To the former he is disposed to answer in the negative; and then from combining many observations he is led to conclude, that one of these poles is situated in North America; that in 1769 it was distant from the pole of the earth 19° 43′, and that its longitude was 259, 58 East, and that it has a perceptible motion towards the east, amounting to about 10′ or 12′. Another of the magnetic poles he conjectures, from similar data, is in the Northern Ocean, and that its position, in 1770, was 4° 11′ from the pole of the earth, and in longitude 101° 29′ 30″ E.; and that it has its motion from west to east, amounting to about 25 per annum.

While on this subject, we may add that the explanation which was given by Mr. Babbage of the magnetical phenomena described by M. Arrogo, has received the strongest confirmation; as in numerous experiments recently instituted by the first of these gentlemen, it has been found that the same appearances take place from electricity which he was led to point out as probable, if the cause which he assigned for the magnetical phenomena were correct.

On the Use of the Telsecope.—The late Sir W. Herschel has remarked, that, "In order to see well with telescopes, it is required that the temperature of the atmosphere and mirror should be uniform, and the air fraught with moisture." Thus a frost after a thaw, or a thaw after a frost, will impair the perfection of the focus: a telescope brought out of a warm room into cold air, or even directed through an aperture of any kind, acts but imperfectly; windy weather is unfavourable to distinct vision, from a mixture of air of different temperatures: an aurora borealis sometimes affects the distinctness of the view, as well as the air ascending from the warm roof of a house: dampness, fogs, and the neighbourhood of moisture, are very favourable to distinct vision with telescopes, except when a fog is so opaque as totally to intercept it. Sir W. Herschel remarks, that some of these obstacles are insuperable; but that the effect of heat may sometimes be remedied by the application of a heated body near the opposite surface of the mirror.

Sir W. also observes, that the central part of a mirror produces a greater aberration in the image of a fixed star than the whole mirror, and the whole mirror a greater aberration than an annular portion remote from the centre: and that this is true of all good mirrors.

NOTICES TO CORRESPONDENTS.

We have to thank "J. A. of Gallashiels" for his hint respecting *Biographical Notices*. The subject had not, however, escaped our attention. We have frequently had it in view to commence a series of these, and have now the pleasure of being able to announce, that we have engaged an intelligent correspondent for the purpose of writing a series of lives. The greater part will be memoirs of individuals whose narratives have never appeared in print, but whose scientific labours fully entitle them to have their names recorded in the annals of their country. We will, nevertheless, of having employed a person for the purpose of writing these, be glad to receive any facts or information from any of our correspondents which may assist our Biographer in the fulfilment of his duty.—"W. B's." communication, we regret to say, would not answer our work. Neither would the acrostics of "L. M'L."—The well merited medal which our publisher bestowed on the labours of Mr. Barnes, was *Gold not Silver*, as was, by mistake, stated in our article on the subject. It may be seen at our publisher's by any person calling.

We are not aware of the well "W. W." writes about having been analyzed. It is impossible to say about what quantity of the water is necessary for him. The quantity that would cure one individual might kill another.—We do not like either the sneers or suggestions of 'Aliquis.' He is as unjust in his remarks as his censures are uncalled for—at least in so far as applies to us. We like to see both Mechanics' Institutions prosper, and we are convinced, that while they continue to be *well managed* and supported, they will prosper, The clause in the laws of the Mechanics' Institution, which gives the power of electing Lecturers to the students may be absurd—nay, we will agree with him in saying it is so, and exactly on the same principle too that he does—a child is not capable of saying, who is the best fitted to teach it English Grammar. But why blame us for it, and the other absurdities he mentions? we did not frame the laws of the Institution, nor had we any say in the affairs of the Institution at the time, or we would at least have used our best endeavour to knock this on the head.

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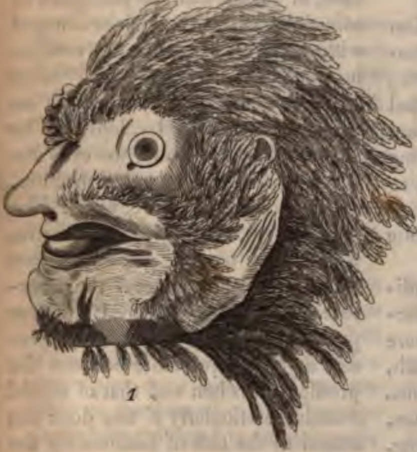
DESCRIPTION OF A HEN HAVING THE PROFILE OF THE HUMAN FACE, &c.



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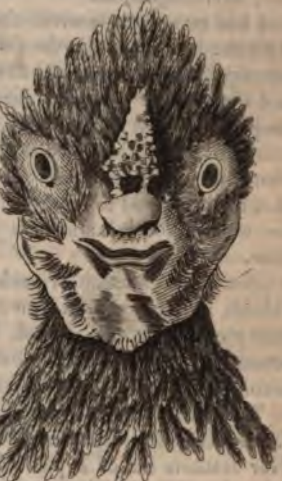

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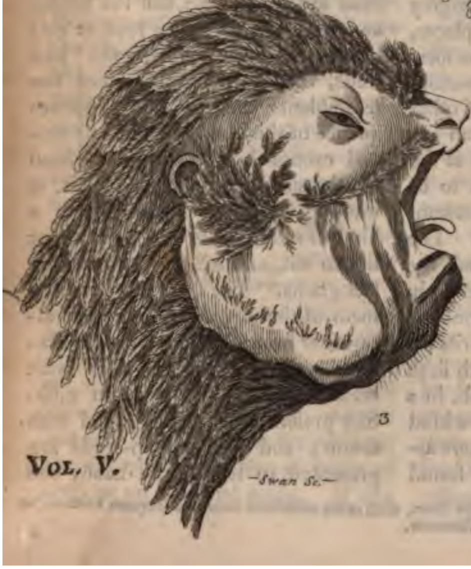

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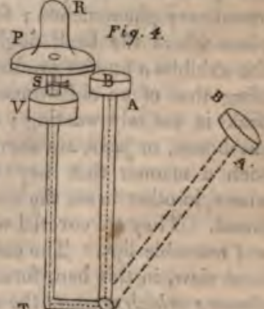

Fig. 4.

DESCRIPTION OF A HEN, HAVING THE PROFILE OF THE HUMAN FACE, WITH SOME OBSERVATIONS.[*]

BY PROFESSOR FISCHER.

(From Dr. Thomson's Annals of Philosophy.)

NEVER has a hen attracted so much attention; never has any animal, even the most rare, so greatly excited the curiosity of the public, as the hen with the human profile, which was found in the district of Belef, in the government of Tula, and sent to the Imperial University of Moscow by his Excellency the Civil Governor, Mr. Bogdanoff.

I had no sooner received this hen with the human profile than the curious presented themselves to see it; and the number of visitors increased so greatly, from day to day, from hour to hour, that frequently my chamber could not contain them; so that I was obliged to fix certain days for exposing this animal to public view.

For the satisfaction of such individuals as have not had an opportunity of seeing this animal, I here present them with a faithful sketch, accompanied with some observations.

The hen is of the middle size, *i.e.* eight inches high, and 14 long. Her feathers are of a pearlish-grey colour, and brown in some places, particularly at the points. The form of her body, as well as her manner of living, is the same as that of other hens; but her head presents an extraordinary phenomenon; for at the place where the beak ought to be she exhibits a human profile, resembling that of an old woman. The beak is entirely wanting; and the jaw-bones, or jaws, are shortened in such a manner that they terminate where, in other hens, the nostrils are found. They are covered with flesh and resemble lips. The comb, in a front view, in this hen, forms a kind of nose; which appears the more astonishing, as the nostrils are found between the termination of this nose and the jaw; but we are most liable to be deceived when we see, as sometimes happens, some drops of liquid in them, or when the dust is accumulated there. To the inferior jaw is attached a fleshy excrescence, not to be found in other hens, and which forms a kind of chin. This chin is bare, or naked, with the exception of some hairs of beard, and is prolonged with naked skin, even to the ears, as in other hens. The eyes are round and black, and surrounded with an iris of a cinnabar-red colour. The parts of the head under the eyes are of a flesh colour, mixed with blue, and almost naked, or covered, like the chin, with a kind of stiff hairs, which form towards the ears a sort of whiskers, and conceal the aperture of the ear. (See fig. 1.) These peculiarities of the head, united, present a great resemblance between the profile of this hen and that of an old woman, particularly if one does not attend to the tuft of feathers on the head of this animal; and the longer and more attentively we look at this profile, especially when the hen feeds, the more striking does the resemblance become. In consequence of this conformation, the animal cannot take the kind of food which suits it. As the beak is wanting, and has for substitute a kind of mouth, it is very difficult for her to eat, and still more so to collect grains. The too great advancement of the nostrils prevents her altogether from drinking; it is, therefore, necessary to feed her with bread soaked in water or in milk. She prefers eating white bread with cream; and when hemp-seeds are presented to her in the hand, she appears to swallow them with avidity; yet she likes, as well as all other hens, hashed meat, corn, &c. I have heard that she has also been seen to eat cheese with much eagerness. She is very tame, as is the case with all birds which have the beak maimed, whether done by the hand of man or by chance. She prefers eating from the hand, as the soft parts about the mouth (the comb and under chin) are soon injured when she is obliged to peck her nourishment on hard bodies.

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[*] *Translated* almost verbatim from the Russ, with some additions from the German Edition, by *Dr. Lyall, Physician* to Count Orlof, at Moscow.

Since I have had her in my chamber, and nourished her from my hand, she knows me very well, and approaches the place where I sit, whether while dining or drinking tea, and calls for something to eat by a particular cry. Her voice, although feeble, resembles that of other hens; and often, when alone, she cackles like a hen about to lay. Notwithstanding the loss of the beak, after having eaten she makes the ordinary motions of the head to wipe and clean the two sides of the jaw upon hard bodies, as on the table or the ground. This hen appears better pleased to be in human society than among other fowls. When another hen is carried into the chamber, and placed near her, she begins to be angry, lets her wings fall, swells and raises herself, and makes a noise like that of a cock which is preparing for combat. In the kitchen she is at continual warfare with the other hens, which she chases; but she herself takes to flight as soon as she perceives the cock. The cock appears now, however, to inspire more confidence; and we have the best founded hope that a favourable connexion will take place between them. In the open air she appears to be timid; and she conceals herself among the grass on the *approach of crows or birds of prey, or on the least noise.* If she happens to be at the chamber window, and to observe crows passing, she sinks at every one of their movements, and gapes with fear. This hen was changing her feathers when I received her, (four months ago,) and the change is not yet finished, which proves that it is more slowly effected than in other hens, because her nourishment, being insufficient, renders her unhealthy; yet the feathers become more thick and lucid, and the plume on the head and neck is become much more bushy. The feet are strong, and the scales which cover them are almost the same as those of a hen of two years of age. She is without spurs; and I am unable to determine whether she was hatched without them, or has lost them in battle, or by cold. On the right foot one nail is deficient, and on the left two.

This is a true description of the hen, and of the facts which I have observed.

I intend now to answer some questions which many of my readers may wish to propose.

First Question.—Does this hen in reality exhibit the profile of a human face?

She is constructed in the same way as other hens; but the more we observe her laterally, the more we find in the profile of the head the resemblance to that of an old woman. But this signifies nothing; it only proves that one object may resemble another; as, for example, that a cloud may have the figure of a lion, or the head of a fly, bruised among sheets of paper, may resemble the head of an American crocodile; and so with a thousand other objects. It is certain that man in his features appears to resemble an animal more or less; as we sometimes see the nose on the human face like an eagle's, but no one is offended. Indeed every one who has observed his fellow creatures with a little attention will have remarked this. This has been observed by Posta, Goree, Lavater, and many others. They have rendered themselves more comprehensible to the senses by figures. Yet there never has been found any animal which resembles man in its exterior form. Whatever has been exhibited of this kind was the effect of imposture, as was the case at Erfurth with the shaved pig with the human hand, and with the shaved bear at Gottingen; as those who have described them have added much more than a reasonable view could possibly discover. I do not wish to enumerate the many writers who have endeavoured, during a certain time, to occupy the imagination of men by figures invented, and said to be the miracles of Nature. In detailing, however, the true nature of the profile of this hen, we do not wish to persuade ourselves that, besides the *visual line*, like that of man, which is produced by the want of the beak, and which is certainly very remarkable, that there is any thing supernatural. By the shortening of the jaws, the comb is found more prolonged, and its extremity is become more thickened, and redder than ordinary, perhaps by the difficulty which she has to peck her nourishment. The redness of the comb and of the chin in these animals appears to vary as the redness of the cheeks of man, which are more or less pale at different times. The thick comb, which at its extremity assumes the form of a bunch of grapes, resembles a nose in front, as well as in profile. The nostrils are found just below the nose; yet they do not ascend, as in the human body, but descend, and terminate in the upper jaw. They are smaller than ordinary, and are unequal, that on the right side even appearing to be closed. By the shortening of the jaws, the mouth is rendered smaller, and thus forms below a kind of bag, which takes the place of the chin. The chin of this hen is nothing else than the enlargement of a *naked skin*, which is found under the throat, or at the jaw of all hens, or an enlargement of the throat itself.

Second Question.—Was the hen hatched with this appearance, or has her beak been shortened, when a chicken, by chance or by art? I think this animal was hatched in the state in which she is; for Nature has constructed her beak, although simple, yet with much art. It is covered in such a manner with horn, which is firmly connected to the jaws, that the beak could not be pulled away without breaking in the middle, injuring a part of the tongue, and thus occasioning the inevitable death of the animal. To render this truth yet more evident, let us suppose a shortening of the beak by art. What would be the consequence of such a mutilation? The sides of the jaw would be uncovered, and that on the right side would always be separated from that on the left. The tongue would be lost, even to the *lamdoidal suture*, and have, by its continual and trembling motion, been extremely difficult to cure; or, in case of repose, would have attached itself to the inferior jaw, and formed one body with it. In fine, the animal would have perished from want, before the cure could have been completed. If we could even suppose the possibility of a less fortunate cure, we should now be able to see the cicatrices of the wounds; yet the parts appear to be connected naturally. The tongue is short and fleshy, and has the form of a triangular and arched spade. (See fig. 3.) In the palate we observe some furrows, which, however, cannot be compared to teeth.

Perhaps it may be opposed to this reasoning that a chick formed in the egg without a beak would not be able to break its calcareous envelope, the shell, and consequently would be unable to get out of it. Although it be true that the chick often opens with its beak the prison in which it is enclosed, during its development; nevertheless it often happens that the shell is burst or split, in all its length, by the growth and nourishment of the chick. Besides, it must be considered that much less force is requisite to break the shell from the interior than from the exterior. We often find an egg with the shell broken, whilst the chick is entirely enveloped in that interior skin, or in that humid envelope, which surrounds it.

Third Question.—Does this singular conformation of the hen indicate something natural? It indicates nothing at all. I would have passed this question in silence, had it not been addressed to me by many individuals. But my answer could not satisfy those who sought, in this extraordinary form, an extraordinary design; because they sought an augury where there was none. Besides, it is not unusual to find chicks deformed, especially in places where they have been hatched by an artificial heat. There we may find some hatched without a beak, without wings, without legs, but they do not attract attenton, as they cannot exist without the assistance of man; and as the poultry dealers only want complete animals, on which they may reckon a neat profit, the most curious are seldom preserved by them for naturalists or the utility of science. Ten years ago there was exhibited publicly in Poland a hen which resembled ours. In short, Nature, though always the most perfect in her works, yet may be led from her usual path by circumstances unknown to man, or at least may be interrupted in her operations. In the process of formation the equilibrium of the seed may be broken by the slightest touch, and produce a protuberance; and the inhabitant of the thickest shell covers with calcareous layers the places which a parasite or a *piercing animal* threatens to bore, even till it has rendered the *smooth place* of its habitation, so small that at length it perishes itself.

The Fourth and Last Question.—In what point of view do naturalists regard this curiosity? Naturalists consider this animal as an irregularity of Nature, *lusus naturæ*, as a monster. Monster is the general term of naturalists and anatomists for every organic body which exists in its formation something removed from the general laws according to which those of its kind are formed. This deviation of nature may consist in the absence, or superabundance, or growth, of some of the parts, or of the organic bodies; and thus they may be double, or in plurality, or in deficiency or deformity of some of the parts, or of the whole. In museums it is not rare to find quadrupeds with two heads, eight feet, &c. Thus by the kindness of his Excellency Mr. Paul Golenuscheff-Kutusoff, Curator of the University, &c., and that of his Excellency Mr. Nicholas Vsevolosihsky, Vice-President of the Medico-Chirurgical Academy, &c. our museum has been enriched with two remarkable objects of this kind—two chickens, each with four feet. Those monsters of the second division, those with deficiency or malconformed parts; such, for example, as living bodies with only one eye. Thus we have in the Museum of the University a stuffed dog with only one eye, placed in the middle of the brow. I have seen here, in Moscow, a living calf with three legs, which could leap very nimbly. Our hen without the beak will always be a great curiosity for our museum; and we are indebted to Mr. Bogdanoff for his politeness and attention.

If the last division, that of deformed or deficient bodies, to which our hen belongs, appears to be more rare, we must attribute it to the want of attention, because we give less heed when parts are wanting than when they are superfluous. An amateur of similar deformities will find a rich treasure of observations in the works of Regnault, Semmering, Blumenbach, and others. It remains for physiologists to shew how such deformities have their origin. May I be permitted just to add here a single idea, which, if it be not itself a sufficient reason, appears, however, to be in the way of facilitating the road to truth. There reigns in all organized nature an eternal tendency to transformation, which may be looked upon as a gradation of increase, according to positive laws. This transformation is most evident in insects and in frogs, which, before arriving at their full size, assume extraordinary forms. But this transformation is not wanting in any organic body, not even in plants, as Goethe shews so well and with so much force, in their green periods (i. *e.* on the earth), and is yet better demonstrated in their first stages (*i. e.* in the first development of the germs of plants, yet enclosed in the earth) than by any other means. This mystery is profoundly concealed in the most elevated classes of animals. It appears to partake of the nature of prodigy when it has attained the most inferior degrees of organization. How great ought to be the transformation which takes places in a drop of water, which, although it appears clear and limpid, encloses myriads of animals in full motion! What eye is able to measure the transformation which takes place in drops of vinegar, where one believes all is dead, whilst in a minute, we see a vibration, and bubbles, which rise in serpentine motions! By the force of this transformation the blood which flows in the vein is changed into animal flesh. Further, who can tell us how this immensity of animals, which live in carcareous shells, as the moluscæ and the polypes, can transform organized matter into lime! Or if we represent to ourselves every organized being, every animal, every plant, according to the degree of their formation, with attention; *i. e.* in the first germ, the first birth of the organic mass, for the form which that being ought to adopt, according to the laws of things, we could easily devise a hindrance, to the development of the *formative virtue*, by which there would result a being incompletely organized or deformed; and by the same intermediate causes there would result a being or animal doubly deformed. The artists Pharof and Osipof, belonging to the University, have prepared a plate of this hen for his Excellency Mr. Golenuschef-Kutusoff; and I have had another prepared for the public, representing the head of its natural size, by Mr. Valesicon the artist.

Explanation of the Plate.

Fig. 1. is a true profile of the hen's face, like to that of an old woman.

Fig. 2. is a front view of the head.

Fig. 3. is a profile view of the head, with the mouth open to shew the tongue.

REVIEW.

AN INTRODUCTION *to the Study of the Laws of* CHEMICAL COMBINATION, *and the Atomic Theory. Drawn up for the Use of Students:* BY EDWARD TURNER, M. D. F. R. S. E., *Lecturer on Chemistry, and Fellow of the Royal College of Physicians, Edinburgh.**

THIS is a small work of 114 pages, very neatly printed. Its price is half-a-crown. The object of the work is two-fold: first, to explain the doctrine of chemical combination, in as far as regards the proportions of the combining bodies; secondly, to explain the nature and the action of what are called hydracids, (that is acids containing hydrogen, but not oxygen, such as sulphuretted hydrogen,) and of the meuteral saline compounds which these acids form with sulifiable bases. The greatest part of the work is taken up with the subject of chemical proportions. This is a subject of which little is known by many whom the novelty and interest of its objects have attracted to the study of Chemistry. All that they care to know is, that two bodies combining together form a new body, with properties distinct from those of its constituents, how much of the one body combines with the other, they do not mind; they think, indeed, that this knowledge must be devoid of philosophical interest, and fit only for the readers of almanacks. Little are they aware, that the investigation of chemical proportions, and the consequent discovery of their laws is the greatest discovery of which the philosophy of matter can boast during the present age; little are they aware, that this discovery has engrossed the attention of the most eminent living philosophers, insomuch that, through the devotion of their labours, there is no set of laws whatever, better established on such a mass of experiment, though their discovery is hardly twenty years old. What was a chaos and covered with darkness, Science first separated—then adorned—and lastly revealed to admiration by the light of philosophy.

Of the work before us we can say, what we could in conscience say of very few of the cheap chemical books that are published now-a-days—that it is written by a man who actually understands the subject upon which he has undertaken to write. In justice, we can say much more,—it is written by a man who, to an accurate knowledge of his subject, adds the talent of clear conception, and the power of communication so as to be easily understood. He found a gap in elementary books on Chemistry; for, though much is scattered up and down in the writings of chemists respecting the doctrine of chemical proportions, yet there was no work in the language to which the student could be referred, as containing an explanation of the subject from the beginning. Such a work has Doctor Turner furnished; and the manner in which it has been executed entitles him to the gratitude of students. We recommend the work to our readers, not only on account of its merit, but also on account of the interest of its subject. The doctrine of chemical proportions has extended our chemical knowledge not less certainly than three-fold. What this doctrine has done for the science, it will do to every one by whom it is studied. It will give precision and extent to the student's knowledge, and while it extends his views it will simplify them.

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* M'Lachlan & Stewart, 1825.

We shall here present our readers with a quotation from Doctor Turner's work, which, while it affords them an opportunity of judging of the style and interest of this work, will, we trust, lead many to a perusal of the whole.

"The first fruit of chemical analysis was the establishment of the fact, that the composition of bodies is definite and invariable; that a compound substance, so long as it retains its characteristic properties, must always consist of the same elements united together in the same proportion. Sulphuric acid, for example, is always composed of sulphur and oxygen in the ratio of 16 parts* of the former to 24 of the latter: no other elements can form it, nor can its own elements form it in any other proportion. Water, in like manner is formed of 1 part of hydrogen and 8 of oxygen; and were these two elements to unite in any other proportion, some new compound, different from water, would be the product. The same observation applies to all other substances, however complicated, and at whatever period they were produced. Thus, sulphate of baryta, whether formed ages ago by the hand of nature, or quite recently by the operations of the chemist, is always composed of 40 parts of sulphuric acid and 78 of baryta. This law, in fact, is universal and permanent. Its importance is equally manifest. It is the essential basis of chemistry, without which the science itself could have no existence.

"The next law to which analysis has given rise is, that two bodies can combine only in a few proportions. Some bodies form but one combination. Thus there is only one compound of zinc and oxygen. Others combine in two proportions. For example, two compounds are formed by copper and oxygen, or by hydrogen and oxygen. Other bodies again unite in three, four, five, or even six proportions. At present we have no satisfactory instance of a greater number, though there is nothing in the nature of things to prevent it.

"A different doctrine was advanced by the celebrated Berthollet in his *Statique Chimique*, published in 1803. He maintained that within certain limits, bodies, had a tendency to unite in all proportions; that combination was never definite and invariable except when rendered so by the operation of certain accidental extraneous causes. These influencing circumstances are cohesion, crystalization, insolubility, elasticity, and the like. Thus according to Berthollet, sulphate of barytes is composed of 40 parts of sulphuric acid and 78 of baryta, not because those substances are disposed to unite in that ratio rather than in any other, but because the compound so constituted has a great cohesive power.

These opinions which, if true, would shake the whole science of chemistry to its foundation, were founded on observation and experiment, backed by all the ingenuity of that highly gifted philosopher. They were ably and successfully combated by Proust, in several papers published in the Journal de Physique, wherein he proved that the metals were disposed to combine with oxygen and with sulphur only in one or two proportions, which were definite and invariable. The controversy which ensued between these eminent chemists on that occasion is remarkable for the moderation with which it was conducted on both sides, and has been properly quoted by Berzelius as a model for all future controversialists. How much soever opinion may have been divided upon this important question at that period, the dispute is now at an end; the infinite variety of new facts, similar to those of Proust, which have since been established, has proved beyond a doubt that the leading principle of Berthollet is quite erroneous.

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* *By the expression* 'parts' I always mean *parts by weight.*

There are some phenomena which may perhaps be regarded as exceptions to the law now stated; those instances, namely, in which combination appears to take place, within certain limits, in every proportion. The most common examples of the kind are the solution of a salt in water, the combinations of silica with the alkalies in the manufacture of glass, and the union of the metals with one another by fusion. It is exceedingly questionable, however, whether these exceptions are not rather apparent than real. For it is probable that the apparent variety of the proportion arises from the mixture of a few definite compounds with each other.

The next law is still more remarkable and unexpected than the preceding. It has given plausibility to an ingenious hypothesis concerning the ultimate particles of matter called the atomic theory. The law itself, however, contains nothing hypothetical, being the pure expression of a fact, first noticed by Mr. Dalton, and subsequently by many other chemists. The nature of it will be at once understood by a simple perusal of the following table.

Water is composed of	Hydrogen	1	Oxygen	8
Dentoxide of Hydrogen	Do.	1	Do.	16
Carbonic Oxide	Carbon	6	Do.	8
Carbonic Acid	Do.	6	Do.	16
Hyposulphurous Acid	Sulphur	16	Do.	8
Sulphurous Acid	Do.	16	Do.	16
Sulphuric Acid	Do.	16	Do.	24
Nitrous Oxide	Nitrogen	14	Do.	8
Nitric Oxide	Nitrogen	14	Oxygen	16
Hyponitrous Acid	Do.	14	Do.	24
Nitrous Acid	Do.	14	Do.	32
Nitric Acid	Do.	14	Do.	40

Now it will be perceived at once, that in all these compounds, the numbers denoting the oxygen, which is attached to a given weight of the same base, bear a very simple ratio to one another. The dentoxide of hydrogen contains just twice as much oxygen as water does. The oxygen in carbonic acid is double that of carbonic oxide. The oxygen in the compounds of nitrogen and oxygen is in the ratio of 1, 2, 3, 4, and 5. So obvious indeed is this law, that it is observed at once when we compare the result of a few accurate analyses together; and the only subject of surprise is, that it was not discovered before. It is by no means confined to the compounds of combustibles with oxygen. Thus the sulphur in the two sulphurets of mercury, the chlorine in the two chlorides of mercury, is as 1 to 2. It extends also to the salts. The bicarbonate of potassa, for example, contains twice as much carbonic acid as the carbonate; and the oxalic acid of the three oxalates of potassa is in the ratio of 1, 2, and 4. We must regard it therefore as a general law, the enunciation of which is as follows. When one body A unites with another body B in two or more proportions, the quantities of B are multiples by a simple whole number of the smallest quantity of B with which A can unite. It is often called the law of multiples, or of combination in multiple proportion.

"Every one who sees this singular law stated for the first time, will naturally inquire if it really holds good in all the numerous compound bodies with which chemists are acquainted. It may be stated in reply, that it has been confirmed by the examination of a great many substances; but that certain exceptions do exist, which render some modification of it necessary for the present. With respect, however, to such exceptions, it is remarkable that more careful analysis and the discovery of new combinations have gradually diminished their number. There is sometimes, indeed, a difficulty in ascertaining whether an exception is real or apparent; for in order to determine it, we must be acquainted with that compound which really does contain the smallest quantity of the variable ingredient. The compounds of sulphur and oxygen afford an ample illustration of this point. A few years ago we were acquainted with only two compounds of sulphur and oxygen, the sulphurous and sulphuric acids; the former of which is composed of 16 sulphur and 16 oxygen, and the latter of 16 sulphur and 24 oxygen. The variable ingredient, or the oxygen was therefore as 2 to 3. But this exception did not exist in nature: it arose purely from our ignorance of the hyposulphurous acid, a compound which was first noticed by M. Gay Lussac in the year 1813. It is composed of 16 parts of sulphur and 8 of oxygen so that the oxygen in the three compounds is as 1, 2, and 3. Arsenic affords us an example of the same kind, in which, however, the anomaly is not yet explained. We know only too combinations of arsenic and oxygen, which are thus constituted:

Arsenious Acid	Arsenic 38	Oxygen 16
Arsenic Acid	38	24

in which the oxygen is as 2 to 3. But we may confidently expect on two grounds that an oxide of arsenic will hereafter be discovered; first, because we have the analogous case of sulphur to justify such a supposition; and secondly, because we should expect arsenic to form, like the other metals, a salifiable base with oxygen. There is, however, one mode of combination, and not a very uncommon one, which, as far as we at present know, does constitute a real exception to the law. An example of this is seen in the compounds of lead and oxygen, whose composition is

Protoxide	Lead 104	Oxygen 8
Deutoxide	104	12
Peroxide	104	16

and the oxygen, therefore, as 1 : 1½ : 2. I shall refer to this subject again immediately.

"There is still another law to be noticed, which is fully as remarkable as the preceding, and is intimately connected with it. Let us take for its illustration water and hyposulphurous acid. The former is composed of 8 oxygen to 1 hydrogen; the latter of 8 oxygen to 16 sulphur. Now it is singular that the well known substance, sulphuretted hydrogen, is constituted of 1 hydrogen to 16 sulphur; that is, the quantities of hydrogen and of sulphur which combine with the same quantity of oxygen, combine with one another. Again, 40 parts of selenium with 8 of oxygen form the oxide of selenium with 1 of hydrogen, seleniuretted hydrogen; 36 parts of chlorine with 8 of oxygen constitute the oxide of chlorine, and with 1 of hydrogen form muriatic acid gas; 16 parts of sulphur combine with 36 of chlorine to form chloride of sulphur.

"It is manifest, from these examples, that bodies unite according to proportional numbers; and hence has arisen the use of certain terms as Proportion, to Combining Proportion, or Equivalent, to express them. Thus the combining proportions of the substances just alluded to are

Hydrogen	1
Oxygen	8
Sulphur	16
Chlorine	36
Selenium	40

"When one body combines with another in more than one proportion, then the law of multiples, already explained, comes into action. Thus,

	Sulphur.	Oxygen.
Hyposulphurous Acid is composed of . .	16 or 1 pr. +	8 or 1 pr.
Sulphurous Acid	16 or 1 pr. +	16 or 2 pr.
Sulphuric Acid	16 or 1 pr. +	24 or 3 pr.

"The most common kind of combination is one proportion of one body either with one or with two proportions of another. Combinations of 1 to 3, or 1 to 4, are very uncommon, unless the more simple compounds likewise exist. Ammonia, however, is a singular instance of the reverse. It is composed of 14 parts of nitrogen, and 3 of hydrogen. Now 14 is the precise quantity of nitrogen that unites with 8 of oxygen, and therefore 14 is considered as one proportion of nitrogen, which is consequently combined with 3 proportions of hydrogen. It is probable that compounds of 1 to 1, and 1 to 2, will hereafter be discovered, but they are quite unknown at present.

"But this law does not apply to elementary substances only, since compound bodies have their combining proportions which may likewise be expressed in numbers. Thus, since water is composed of one proportion or 8 of oxygen, and one proportion or 1 of hydrogen, its combining proportion is 9. The proportion of sulphuric acid is 40, because it is a compound of one proportion, or 16 of sulphur, and three proportions or 24 of oxygen; and in like manner, the combining proportion of muriatic acid is 37, because it is a compound of one proportion or 36 of chlorine, and one proportion or 1 of hydrogen. The proportional number of potassium is 40, and that quantity combines with 8 of oxygen to form potash; hence the combining proportion of potash is 48. Now when these compounds unite, one proportion of the one combines with one, two, three, or more proportions of the other, precisely as the simple substances do. The hydrate of potash, for example, is constituted of 48 potash and 9 of water, and its combining proportion is consequently $48+9$ or 57. The sulphate of potash is composed of 40 sulphuric acid $+$ 48 potash; and the muriate of the same alkali of 37 muriatic acid $+$ 48 potash. The combining proportion of the former salt is therefore 88, and of the latter 85.

The composition of the salts affords a very neat illustration of this subject; and to exemplify it still further, I subjoin a list of the proportional numbers of a few acids and alkaline bases.

Fluoric Acid . .	10
Phosphoric Acid .	28
Muriatic Acid . .	37
Sulphuric Acid .	40
Nitric Acid . .	54
Arsenic Acid . .	62

Lithia . .	18
Magnesia .	20
Lime . .	28
Soda . .	32
Potash . .	48
Strontia . .	52
Barytes . .	78

"It will be seen at a glance, that the neutralizing power of the different alkalies is very different, for the proportion of each base expresses the precise quantity required to neutralize a proportion of each of the acids. Thus 18 of lithia, 32 of soda, and 78 of baryta, combine with 10 of fluoric acid, forming the neutral fluates of lithia, soda, and baryta. The same fact is obvious with respect to the acids; for 28 of phosphoric, 40 of sulphuric, and 62 of arsenic acid unite with 28 of lime, forming a neutral phosphate, sulphate, and arseniate of lime.

"These circumstances afford a ready explanation of some phenomena which I have observed to occasion much difficulty to students. The first was originally noticed and accounted for by the Saxon chemist, Wenzel, and may be thus stated:—when two neutral salts mutually decompose one another, the resulting compounds are likewise neutral. The cause of this fact is now obvious. If 88 parts of neutral sulphate of potash are mixed with 132 of the nitrate of baryta, the 78 baryta unite with the 40 sulphuric acid and the 54 nitric acid, of the nitrate combine with the 48 potash of the sulphate, not a particle of acid or alkali remaining in an uncombined condition.

Sulphate of Potash.	
Sulphuric acid	40
Potash . .	48
	88

Nitrate of Baryta.
54 Nitric acid.
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"It need hardly be mentioned, that it matters not whether more or less than 88 parts of sulphate of potash are added; if more, a small quantity of sulphate of potash will remain in solution; if less, muriate of baryta will be in excess; but in either case the neutrality will be unaffected."

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BAROMETRICAL AIR PUMP.

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is a vessel of wood or iron ; J A is a pipe of the same ma- s with an air-tight joint ; at T B is another vessel of the same equal in capacity to V ; a pipe h a stop-cock connects V with ump plate. There is an ori- t B to allow air to escape.

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This machine might be easily constructed, and if the vessels were small no great quantity of mercury would be required. The stop-cock might be made to act by the motion of the pipe T B.

A. B.

Dollar, 27th June, 1826.

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Strontia . .	52
Barytes . .	78

" It will be seen at a glance, that the neutralizing power of the different alkalies is very different, for the proportion of each base expresses the precise quantity required to neutralize a proportion of each of the acids. Thus 18 of lithia, 32 of soda, and 78 of baryta, combine with 10 of fluoric acid, forming the neutral fluates of lithia, soda, and baryta. The same fact is obvious with respect to the acids; for 28 of phosphoric, 40 of sulphuric, and 62 of arsenic acid unite with 28 of lime, forming a neutral phosphate, sulphate, and arseniate of lime.

" These circumstances afford a ready explanation of some phenomena which I have observed to occasion much difficulty to students. The first was originally noticed and accounted for by the Saxon chemist, Wenzel, and may be thus stated:—when two neutral salts mutually decompose one another, the resulting compounds are likewise neutral. The cause of this fact is now obvious. If 88 parts of neutral sulphate of potash are mixed with 132 of the nitrate of baryta, the 78 baryta unite with the 40 sulphuric acid and the 54 nitric acid, of the nitrate combine with the 48 potash of the sulphate, not a particle of acid or alkali remaining in an uncombined condition.

Sulphate of Potash.	
Sulphuric acid	40
Potash . .	48
	88

Nitrate of Baryta.
54 Nitric acid.
78 Baryta.
132

" It need hardly be mentioned, that it matters not whether more or less than 88 parts of sulphate of potash are added; if more, a small quantity of sulphate of potash will remain in solution; if less, muriate of baryta will be in excess; but in either case the neutrality will be unaffected."

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BAROMETRICAL AIR PUMP.

principle on which this machine is similar to that of the barome-

is a vessel of wood or iron; J A is a pipe of the same ma- s with an air-tight joint; at T B is another vessel of the same , equal in capacity to V; a pipe th a stop-cock connects V with ump plate. There is an ori- t B to allow air to escape.

the vessel V, and the tubes V, nd J be filled with mercury, the communication with the re- r R be then opened, and the J A moved to the position J he air in the receiver will press the surface of the mercury till lasticity of the air in the vessel ogether with the pressure of the mn of mercury in the pipe V T qual to the atmospheric pressure, her with the pressure of a simi- lumn of the same vertical height as the vessel A′. By this means the mercury may be depressed below the vessel V; and then by elevating the pipe J A′ to its vertical position, and turning the stop-cock S to shut the communication with the receiver, and open one with the external air, the air will flow from the vessel V by the pressure of the mercury in T B′, through the stop-cock to the atmosphere, and V will then be filled with mercury as before; and the same operation may be continued till the receiver be sufficiently exhausted.

This machine might be easily constructed, and if the vessels were small no great quantity of mercury would be required. The stop-cock might be made to act by the motion of the pipe T B.

A. B.

Dollar, 27th June, 1826.

proportion or 36 of chlorine, and one proportion or 1 of hydrogen. The proportional number of potassium is 40, and that quantity combines with 8 of oxygen to form potash; hence the combining proportion of potash is 48. Now when these compounds unite, one proportion of the one combines with one, two, three, or more proportions of the other, precisely as the simple substances do. The hydrate of potash, for example, is constituted of 48 potash and 9 of water, and its combining proportion is consequently 48+9 or 57. The sulphate of potash is composed of 40 sulphuric acid+48 potash; and the muriate of the same alkali of 37 muriatic acid+48 potash. The combining proportion of the former salt is therefore 88, and of the latter 85.

The composition of the salts affords a very neat illustration of this subject; and to exemplify it still further, I subjoin a list of the proportional numbers of a few acids and alkaline bases.

Fluoric Acid . .	10
Phosphoric Acid .	28
Muriatic Acid . .	37
Sulphuric Acid .	40
Nitric Acid . .	54
Arsenic Acid . .	62

Lithia . .	18
Magnesia .	20
Lime . .	28
Soda . .	32
Potash . .	48
Strontia . .	52
Barytes . .	78

"It will be seen at a glance, that the neutralizing power of the different alkalies is very different, for the proportion of each base expresses the precise quantity required to neutralize a proportion of each of the acids. Thus 18 of lithia, 32 of soda, and 78 of baryta, combine with 10 of fluoric acid, forming the neutral fluates of lithia, soda, and baryta. The same fact is obvious with respect to the acids; for 28 of phosphoric, 40 of sulphuric, and 62 of arsenic acid unite with 28 of lime, forming a neutral phosphate, sulphate, and arseniate of lime.

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In the course of Doctor Turner's work, there are some opinions expressed by him, especially in the latter part of his work, which are not free from exception. Properly speaking, these exceptions are not chargeable to Doctor Turner, as the opinions to which we allude are generally held by Chemists. Doctor Turner has well accomplished his task, that of explaining the views actually entertained by the generality of chemists.

BAROMETRICAL AIR PUMP.

The principle on which this machine acts is similar to that of the barometer.

V is a vessel of wood or iron; V T J A is a pipe of the same materials with an air-tight joint; at T and B is another vessel of the same kind, equal in capacity to V; a pipe S with a stop-cock connects V with the pump plate. There is an orifice at B to allow air to escape.

If the vessel V, and the tubes V, T, and J be filled with mercury, and the communication with the receiver R be then opened, and the pipe J A moved to the position J A′, the air in the receiver will press down the surface of the mercury till the elasticity of the air in the vessel V, together with the pressure of the column of mercury in the pipe V T be equal to the atmospheric pressure, together with the pressure of a similar column of the same vertical height as the vessel A′. By this means the mercury may be depressed below the vessel V; and then by elevating the pipe J A′ to its vertical position, and turning the stop-cock S to shut the communication with the receiver, and open one with the external air, the air will flow from the vessel V by the pressure of the mercury in T B′, through the stop-cock to the atmosphere, and V will then be filled with mercury as before; and the same operation may be continued till the receiver be sufficiently exhausted.

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A. B.

Dollar, 27th June, 1826.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

SECTION IV.

7. *Souring.*—Since the time of Dr. Holme, who introduced sulphuric acid souring, there has been but little improvement made in this department of the Art of Bleaching. It always follows the boiling in alkaline lyes, and is among the finishing processes. The goods are removed from the dash wheel to the souring vats, and exposed to the actions of the sulphuric acid, in the same way as they are steeped at the commencement of the operation. It assists and expedites the process very much, if the goods are dried before being put into the sour, for a reason which was formerly given in the directions for bucking, but for this there is not always time. The acid is to be diluted till it can be taken with safety into the mouth, so as to indicate to the taste the strength of strong vinegar, or lemonade, or it may be tried by the hydrometer, and Mr. Parke's tables, the specific gravity being proportioned and accommodated to the fabric of the goods. The Irish bleachers use 100 parts of water, to dilute one part of sulphuric acid; the French at Mayenne 60 to one by measure. The same precaution is to be taken here, as in bucking, with regard to the equal mixture of the acid and the water with which it is diluted, for as the acid is poured into the water, and the former being twice the specific gravity of the latter, the acid will sink indiluted to the bottom, if care be not taken to agitate and mix it. Want of attention to this circumstance, was one of the causes which prevented the speedy introduction of this mode of souring when it was proposed, for the bleachers, being ignorant of the imperfect state of the mixture, fearlessly put in their goods which were speedily corroded. The goods are usually suffered to remain in the sour for twelve hours, if they are put in dry, a shorter period will be sufficient, and it will be farther expedited by having the water milk warm, or even as warm as the hand can easily be held in it. It is of the utmost consequence to have the remains of the acid completely removed after the souring, because if the cloth is allowed to dry before washing, the condensation of the acid will infallibly corrode it. The less the goods are pressed in the vat, the better they will be exposed to the action of the acid; it was probably wantof attention to this, which gave rise to prejudices against the use of acids. Whether they are sufficiently cleared of it, may be ascertained by applying the tongue, when the absence or presence of an acid will indicate the continuance or discontinuance of the washing.—(*Dublin Report*, 1791.)

8. *Finishing Process.*—After souring and a thorough washing, the goods are examined, to see whether the operations have been successful in bringing them to a pure white. For this purpose, as the perfection of the bleaching can be better judged of when they are wet, the pieces are to be run through water, and passes from it so gradually over a roller as to give the superintendant an opportunity of examining every inch of the surface. Cottons

intended for calico printing may be run once or twice through a madder copper of the temperature of 180°, which will mark any part that may be imperfectly bleached. If any are found not to be fully white, they are returned to the workmen to go through a second course of bucking, immersion, and souring. Those which are found to possess the requisite whiteness are pressed clear of water, and a bluish cast given to them to make the white look clearer. This is done in two ways: either by diffusing in the usual way a small quantity of fine indigo, through a hot or cold solution of white soap; and immersing the goods in it, or they may be immersed in a solution of white soap, without any kind of blue, while it still contains a small portion of the acid. If the latter is employed, the small portion of acid in the cloth immediately exhibits in the vat a slight tinge of Berlin blue, arising from the particles of iron combined with the alkali of the soap, which tinge is distributed very equally on the whole piece. This method is liable to uncertainty from a nicety of management required for complete success, and only those therefore who have some experience should attempt it, but it is recommended by its economy. A sufficient quantity of the solution of indigo must be prepared for every particle of goods to be blued, that it may not be necessary to make additions to it during the process, otherwise different shades of blue would be produced. The goods should be plunged into it at the moment the colour is suspended, and they should be left no longer than is necessary for imbibing it. It is not easy accounting for a fact observed by Des Charmes, that some pieces, after being taken out of the bleaching liquor, and undergone an immersion in the sulphuric acid sours, still retain a sufficient quantity of muriatic acid (derived from the chlorine) to cause them to assume a yellowish tinge, after they had passed through an infusion of indigo. This tinge indeed is common to almost all goods which pass through any preparation of chlorine, but is commonly removed with ease by crofting, souring, or immersion in the solution of soap. For the calendering and manipulations I refer to Des Charmes, as it does not fall within my plan.

9. *Epitome of all the processes.*—I shall now bring all the processes into one distinct view, giving Mr. Ramsay's account of the order and number of them employed in Glasgow and in Ireland. A parcel says he of 360 pieces of linen of the sort called Britanicas, weighing 3600 lbs. are first steeped, then

1. Bucked with 60 lb. pearl-ashes washed crofted.
2. Do. 80 lb. Do. Do. Do.
3. Do. 90 lb. pot-ashes Do. Do.
4. Do. 80 lb. Do. Do. Do.
5. Bucked with 80 lb. pearl-ashes washed crofted.
6. Do. 50 lb. Do. Do. Do.
7. Do. 70 lb. Do. Do. Do.
8. Do. 70 lb. Do. Do. Do.
9. Soured one night in dilute sulphuric acid, and washed.
10. Bucked with 50 lb. pearl-ashes—washed—crofted.
11. Immersed in oxymuriate of pot-ash or lime twelve hours.
12. Boiled with 30 lb. pearl-ashes—washed—crofted.
13. Do. do. do. do. do.
14. Soured—washed—blued—mangled or calendered.

10. *Bleaching of Calicoes—Muslins—Hose—Thread, &c.*—In bleaching for Calico printing, the process is very similar to that we have already detailed, the chief difference lies in the number of the buckings, and the strength of the lyes, as the colouring matter of cotton is much more soluble than that of linen;—and sometimes, when the weather is favourable for crofting, intermitting the immersions

in the chlorine preparations. To remove or destroy the reddish hue arising from boiling printed cottons in madder decoctions, which prevents the printed colours appearing to advantage; thegoods are usually boiled for some time in bran and water, and then exposed to the air by wet crofting. Mr. Grimshaw of Belfast, in 1796, obtained a patent for clearing printed goods coming from the madder copper, by using the grains after brewing malt liquor, (Draff *Scotice*) instead of bran.—*(Rees' Cycl. Bleaching.)* In bleaching ginghams and pulicates, where part is woven coloured, and part white, the oximuriate of pot-ash is found to be the best agent, together with very dilute sours of sulphuric acid. No bucking is used, but the goods are gently boiled in a solution of soap, previous to immersion in the chlorine preparation. When the whites have been bleached before weaving, the goods are merely washed, and put into a sulphuric acid sour. The chief difference in bleaching thread —hose—night-caps, and other small articles, consists more in the manipulations than in the chemical process, for which I refer to Pajot Des Charmes *passim*, for minute and practical directions, for wringing—folding—unravelling, &c. &c. For the Indian mode of Calico bleaching, see Dr. F. Buchanan's journey through the Mysore, vol. I. p. 223.

MISCELLANIES.

Mathematics.—Mathematicians are always found more eager to continue and extend the theories of others, than to investigate the original primary proposition, and it is difficult to obtain any reasoning upon a theory, but what has been copied from the works of the original inventor: they are willing to admit a theory correct, because they find the mechanical detail so: to calculation they are accustomed; but the abstruse theoritical part requires an exertion of the mind, which being rarely necessary, so the mind is seldom fit for such exertion. Hence, when the theory becomes extended, the results are found contradictory, at variance with practice, and often with common sense. We find Bossut determining, with Soufflot, that the parabolic arch of equilibration should be thicker at the springing than at the vertex. But Berard finds that they are both wrong, and it ought to be thicker at the key than at the springing, and agrees with Emerson in this respect, though he differs widely in every other. Bossut and Berard again differ in determining the intrados, and in the case of the minimum of materials to an abutment; and they both differ from Epinus, who treated of this subject in the Berlin Memoirs, 1825. We find the asymptote of the Emerson theory vertical, when the tangent at the springing of the arch is so, and consequently the weight from the haunch to the springing, infinitely increasing, without any power in man to fulfil this supposed law of nature: but by the same theory, hyperbolic and parabolic arches are found to increase from the springing to the vertex; so that here the strength decreases as the weight increases.

When the theories are extended to domes, results of the most extraordinary character are produced; we find a vertical line passing through the vertex, an asymptote; the extrados being terminated at the vertex by a *fleche infinie;* but these phænomena were not discovered by Bouguer, Bossut, and Robison. Soufflot's knowledge of geometry is even questioned, because he did not terminate the dome of the Pantheon Francois *en fleche infinie.* It has been asserted, not very humbly, by the followers of the Emerson theory, that "the wedge theory of La Hire is now completely exploded," and that the theory which they follow is the "only true one."

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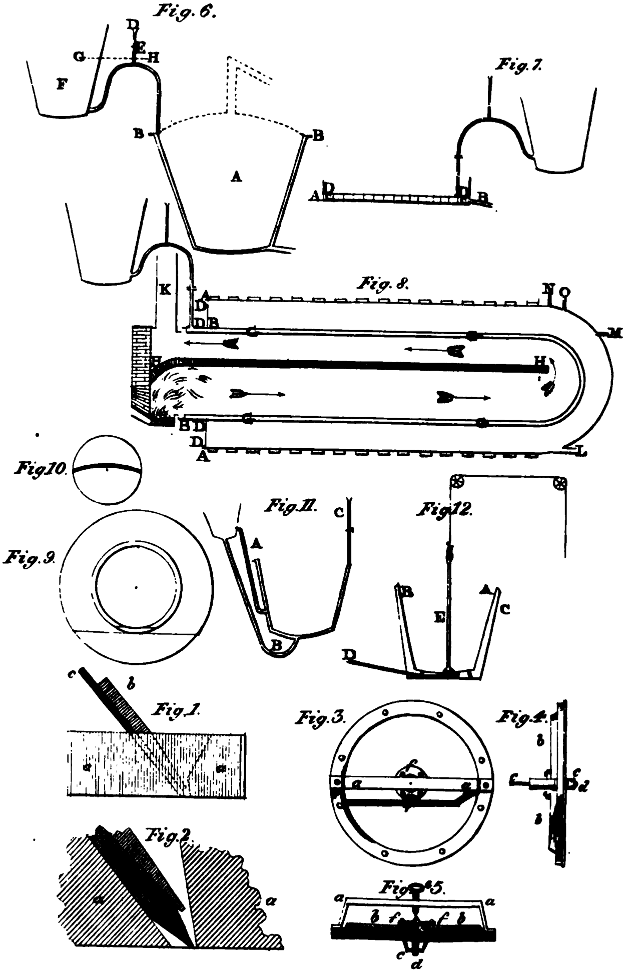
MECHANICS' MAGAZINE,
CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

"Oh! mark the sleepless energies of thought!"—*Rogers.*

No. CXXXIV. *Saturday,* 15*th July,* 1826. Price 3d.

DOUBLE BEVELLED PLANE; SAFETY VALVE FOR STEAM BOILERS; APPARATUS FOR THE CONCENTRATION AND CRYSTALLIZATION OF ALUMINOUS SOLUTIONS.



— J.Swan Sc. —

VOL. V.

DESCRIPTION OF A DOUBLE BEVELLED PLANE FOR SMOOTHING HARD OR COARSE GRAINED WOODS.

By Mr. C. Williamson, New-Street, Elizabeth-place, Kennington-Cross.

From the Transactions of the Society of Arts, &c. Vol. XLIII.

My improvements in the double bevelled plane consist in making the plane-iron of the finest cast-steel, and also in making it with two bevels: that is, bevelling it on both sides, by which means one iron becomes superior in its operation to the double iron that is adopted in the best planes.

To obtain this effect, I have made it sufficiently strong to resist the wedge, and to prevent its breaking by any inequality that might be in the wood or steel. The edge, by means of the two bevels, becomes much stronger, will continue its keenness much longer, and will cut much smoother than any plane with which I am acquainted.

It appears to me that planes had originally but one iron, bevelled on one side; such are yet in use, but are very imperfect tools; that they were materially improved by the addition of a top iron, which, acting as an upper bevel, is the cause of the double-iron plane cutting better than the single-iron plane; but even then the working iron, if I might so term the lower iron, has but one bevel, which causes it to be far from a perfect tool to cut hard or coarse wood.

It appears to have been a desideratum for some years to employ cast steel for plane-irons, on account of the fine and durable edge that it admits, superior to any other steel; for this purpose a plan was adopted of soldering cast-steel to cast-iron; but experience proved to the users of planes that, however good the plan might appear in theory, it did not answer in practice; for it was no uncommon occurrence in using such, for the steel to be forced from the iron to which it had been soldered; and when this did not occur, yet if the tempering was imperfect it could not be corrected in common practice by any ordinary workman, and I believe they are now nearly out of use. Another plan was to make plane-irons wholly of cast-steel, but these were only with one bevel, and the inequality of the surface, as well as the brittleness of the steel, caused these cast-steel irons to break in a short time, when used for common work, as they could not be made thicker than the welded one, on account of the top iron; thus this plan also failed.

The superiority of two bevels is generally acknowledged in the use of turning tools, of axes, &c. but the principle has never, as far as I know, been adopted in plane-irons prior to my application of it.

Thus it appears that the advantages gained by a cast-steel single-iron, made sufficiently thick to be bevelled on both sides, are a finer and more durable edge than can be obtained by any other steel; little risk of the iron breaking on account of its additional thickness; the plane not chocking; there being no top iron, and therefore no loss of time in fitting it; and its producing a smoother surface than any plane now in use.

Mr. Williamson is in the employ of Messrs. Whiting and Branston; the latter of which gentlemen attended the committee, and stated that he has seen the candidate's plane in use for smoothing box wood to be engraved upon; that it cuts very smoothly and evenly, more so than other planes; and that the surface formed by it scarcely requires to be finished by the subsequent application of the scraper.

Reference to the Plate.

Fig. 1. is a longitudinal vertical section of the plane: *a a* the body: *b* the wedge: *c* the plane-iron. Fig. 2. shews the bevelled part of the iron *c*, and the end of the wedge *b* full-sized.

DESCRIPTION OF A SAFETY VALVE FOR STEAM-BOILERS.

BY MR. C. SOCKL, 17, ROYAL ROW, LAMBETH,

From the Transactions of the Society of Arts, &c. Vol. XLIII.

I TAKE the liberty of submitting to the consideration of the Society a safety valve for a steam boiler, which, in my humble opinion, is new, and will afford great security, particularly on board a vessel.

I have got one of my valves fixed upon a small model of a boiler which is in operation; should it be desired by the committee to see the action of it, I shall be happy to attend.

I propose, that instead of the solid lid which covers the main hole, a copper plate or dish be substituted, as shewn in figs. 3, 4, 5, where *b b* is the copper dish, surrounded by a ring of the same, by which the plate is firmly screwed down upon the rim of the main hole. In the middle of this plate is fixed the valve, of which *f f* is the collar, made of iron or brass: *d* the plug, which is ground air-tight into the collar, and is kept in its place by the spiral spring which surrounds its stem, and the stay *c*; over the whole is fixed a strong cross piece, *a a*, which is firmly screwed down upon the ring that secures the plate *b*. In the cross piece works a regulating screw, *e*, which may be screwed down upon the head of the plug *e*. The operation of the valve is easy to understand; *a*, the plate or dish, is only one-fourth or one-third the thickness of the other parts of the boiler; it will not afford the same resistance to the steam; when this, therefore, gets beyond the ordinary pressure, it will cause the plate to become somewhat convex, and will thus leave a clear space between the collar, *f*, and the conical plug, *d*, for the steam to escape. As soon as the power diminishes, the plate will, by its elasticity, return to its former place, and by closing down upon the plug, prevent any further escape of steam.

APPARATUS FOR THE CONCENTRATION AND CRYSTALLIZATION OF ALUMINOUS AND OTHER SALINE AND CRYSTALLIZABLE SOLUTIONS, PART OF WHICH APPARATUS MAY BE APPLIED TO THE GENERAL PURPOSES OF EVAPORATION, DISTILLATION, INSPISSATION, AND DESICCATION, AND ESPECIALLY TO THE GENERATION OF STEAM.

By Josias Christopher Gamble, of Liffybank, Dublin, Chemist.

Fig. 6. *a*, the boiler, consisting of two metallic vessels placed the one within the other. The flanches, *b b*, at top are formed to correspond, and are made air-tight by screws and cement in the usual way. The inner is separated from the outer vessel by a space of two or three inches at bottom and sides. The outer vessel has a stroop at the bottom for drawing off the contents of the intermediate space. The boiler is set over a furnace in the usual way, which it is unnecessary here to describe. *c* is a curved pipe, from one to two inches in diameter, more or less, according to the dimensions of the apparatus. The curve rises about eighteen inches, and its legs stand distant from each other about two feet. D is an air pipe, proceeding from the most elevated part of the curved pipe, about one inch in diameter, provided with a stop cock at E, and rising as high as the reservoir F. One leg of the curved pipe is attached at B to the flanch of the inner compartment of the vessel A. The other leg is attached to the side of the reservoir F, and thus a constant communication is maintained between the chamber of vessel A and the reservoir F. The outer and inner compartments of the vessel A are denominated the chamber, the fluid it contains the medial fluid, and the liquid to be operated on the boiling liquid. In using this apparatus pour into the reservoir, F, my liquid, the boiling point of which is thirty-five degrees or more higher than the liquid to be boiled. As soon as said liquid rises as high as the dotted line G H, it passes through the curved tube, fills the chamber between the two compartments of the boiler A, and expels the air therefrom through the air pipe D. As soon as the chamber is filled, and the medial liquid remains stationary at the line G H, that is, above the level of the curved pipe; the interior of the vessel, A, may be filled with the boiling liquid, and the fire lighted in the furnace. As soon as the medial liquid is raised about thirty degrees higher than the boiling point of the boiling liquid, the latter will commence boiling, while the medial fluid will not itself boil. The inventor has uniformly remarked the important fact, that any fluid medium, forming a stratum of two or three inches in diameter, as represented in the above apparatus, cannot have its temperature raised higher than from thirty to thirty-two degrees higher than the liquid in the interior boiler. In other words, he finds the conducting power of the medial liquid in the inner vessel, and the boiling fluid, so great, that the heat is expended in evaporating the boiling liquid as fast as it is communicated by the fire to the medial fluid. To form a distillatory apparatus, the interior compartment of vessel A may be constructed with a dome and eduction pipe, as represented by the dotted lines in fig. 6; or it may take any other form required, the species of metal being always adapted to the objects in view. One reservoir will suffice for any number of boilers, when communicating by a main pipe with their curved tubes. But its capacity must at least equal one-eighth the capacity of all the chambers of said boilers, in order to leave room for the expansion of the medial fluid when heated.

Though the above form of apparatus is preferred for the purpose of evaporation, distillation, &c. the inventor gives it various modifications, as circumstances may require. He sometimes gives it the form of a flat parallelogram, A B, fig. 7. In this form he makes it of hammered iron or copper. The chamber, C C, is two or three inches in depth, and has its top and bottom strengthened by strong rivets, as represented in the figure. The boiling compartment, D D, is from eight to twelve inches in depth. The curved pipe is attached to the most elevated corner of the upper compartment of the chamber, and resembles in all other respects, as well as does the reservoir, the curved pipe and reservoir of fig. 6.

The apparatus for generating steam is formed of three cylindrical vessels, open at one end, and closed and semiglobular at the other, as represented by fig. 8. The middle vessel, B B, is introduced into the outermost vessel, A A, and retained in its central position by means of a small iron roller, as is seen by the end view, fig. 9. At the open end they are closed by a circular rim, with double flanches, D D, secured with screws and cement in the usual way. The outmost and middle vessels being firmly secured, the inmost vessel, E E, is introduced into *the middle vessel,* B B, and retained *in its position by a roller* similar to that before-mentioned. The inmost vessel has a rim, F F, projecting three inches all round beyond its circumference. This rim is fitted and jointed to the middle cylinder, and by its projection adjusts the dimensions of the chamber, G G. The curved pipe of communication between the chamber, G, and the reservoir, is attached to the middle cylinder at F. The middle and inmost cylinders must extend six inches beyond the outmost, to leave space for their junction as well as the junction of the curved pipe with the chamber. A brick arch is constructed within the inmost cylinder, springing from a little below its centre and extending to within a foot of the further end. The fire is placed in front of and below this arch. The flame passes below the arch till it reaches the lower end of the cylinder; it then rises and returns above the arch, and enters the chimney, K. L, a pipe to clear off any sediment that may fall from the water to the bottom of the outer cylinder: M, a similar pipe for cleaning the top of the middle cylinder. The outmost vessel, though called a cylinder, is not strictly so. It is made smaller at its semiglobular end, in order to receive a number of stout cylindrical hoops, like those used in shoeing strong cart wheels. These are driven firmly on the cylinder, and add greatly to its power of resisting pressure. At the circular end of the boiler may be placed the steam and feeding pipes, as at N O. The advantages of this apparatus are these. First, the form of the outward cylinder, and the strong hoops of malleable iron by which it is surrounded, give it great power of resisting the force of high pressure steam. Second, the lengthened circuit given to the flame by means of the returning fluel greatly economises heat. Third, the medial fluid being capable of heating the water in the boiler within thirty degrees of its own temperature, gives us the command of very high-pressure steam. If fixed oils, for instance, were the medial fluid, the water in the boiler might be safely raised to four hundred degrees of temperature, which would put under our command a power not hitherto successfully employed by the steam-engine. Fourth, with this apparatus we can work in perfect security, and dispense with the use of valves. Let the outer cylinder be made of sufficient strength to resist the force of steam raised to the temperature of the boiling point of the medial fluid, and it is evident an explosion can never happen; because the boiling water, receiving its heat from the medium, never can become hotter than that medium. And as the medium, not being confined by pressure, can never be raised above its boiling point, so the boiling water can never exceed, or even reach, that boiling point. Thus, notwithstanding the vastly increasing force of high-pressure steam, it will be always in our power, by means of the strong hoops of malleable iron above referred to, to give to the outer boiler a power of resistance greater than the force of steam applied to it. The middle cylinder, from its form and position, will always be superior to any force it can have to bear. When the medial fluid consists of animal or vegetable oil, it will be advisable to confine its temperature considerably below its boiling point, say to about four hundred degrees of Fahrenheit, to guard against its decomposition. For the same reason the middle cylinder should be kept completely covered with boiling water. Should the medial fluid at any time boil into the reservoir, it is indication of the engine rising to too high a temperature, and consequently of the excessive force of the steam. The inventor sometime constructs boilers of an outer and inner, and dispenses with the middle cylinder and the medial fluid. The flame is made to circulate by means of the brick arch; the junction at the mouth is formed in the same manner as the outer and middle cylinders of fig. 8, and the outside vessel is hooped round in a similar way. But as the heat is not applied to the boiling liquid by means of a fluid medium, the customary safety valves are thereby rendered necessary. The curved tube in all the figures represents the form for connecting the chamber with the reservoir; but a tube answering the same purpose might proceed from the bottom or side of the chamber, and connect itself with the reservoir. In this case it would be necessary to give the tube an inclination downwards, to prevent the hot fluid from the chamber passing into the reservoir, an event that never should occur. It must also have an air-pipe at the most elevated part of the chamber, see fig. 6. A, one form of communicating tube between the chamber and reservoir: B another form: C the air-pipe. Mr. Gamble does not claim as his invention the double vessels with their chambers, fig. 6, 7, and 11, such vessels having been used for high-pressure steam, and various other purposes; but he claims the invention of the communicating tube and reservoir, by which such vessels can be more advantageously applied than hitherto to useful practice. Neither does he claim the use of any particular medial liquid. For low heats, as the distillation of ether or alcohols, the inspissation of extracts, or drying of powders, he recommends water, or a saturated solution of common salt. When higher heat is required, many other salts will be found answerable; but for boiling any liquid whose boiling point does not exceed two hundred and twenty-five degrees, he prefers a strong solution of muriate of lime, the boiling point of which may be carried from two hundred and fifty to three hundred, according to its density. For higher heights, as the boiling of sugar, or for high-pressure steam, not exceeding thirty pounds to the square inch, he would recommend essential oils, especially oil of coal tars, on account of its great cheapness. Where still higher heats are requisite, the fixed animal and vegetable oils must be employed. In evaporating alum, and many saline solutions, it will be requisite to line the boiler with lead, or such metal or substance as will resist the action of the boiling liquid. In this case it will also be requisite to have a much greater difference between the boiling point of the medial fluid and that of the boiling liquid. From fifty to sixty degrees of difference he found necessary. The vessel he employs for crystallization of alum and other saline and crystalline substances, is seen in fig. 12. A B, a vessel of cast iron, or other suitable metal, wider at the mouth than at the bottom. Said vessel may be fixed on or below the ground, on a solid foundation; from which foundation it must be separated about four inches, by three or more pillars: C C a brick wall, surrounding the vessel, and leaving a space all round its side to admit the circulation of steam: D a steam-pipe, passing from a steam-boiler through the brick wall, and to the centre of the bottom of the vessel: E a staff, resting on the centre of the bottom of the vessel, and rising above it, having a ring on its upper end, and a large knob at its base. The staff is placed on the bottom of the vessel before the crystallizing liquid is poured in. When the crystalline mass is ready for withdrawing, a chain from a crane is attached to the ring of the staff; steam is admitted round the vessel for five or ten minutes, more or less, according to its quantity; and when the upper part of the crystal in contact with the metallic vessel is observed in a slight degree to liquefy, the crane is turned, and the entire mass of crystals is elevated and removed to a proper place for breaking up the crystals and receiving the mother waters. Where crystals less solid than alum are made, a broad plate, instead of a knob, may be attached to the staff. In large manufactories, where many crystallizing vessels are required, place the crane in the centre, and form one or two circles of the crystallizing vessels around. Leave a breach in the circle where the alum, &c. may be broken up, and a channel formed to convey the liquor to the reservoir. For alum and many other salts, the crystallizing vessels and staff must be lined with lead, or such material as will resist the action of the liquor. The case surrounding the vessel may be of wood, or other suitable material, instead of the brick wall, and may be made fixed, or moveable at pleasure. Reference to fig. 8: H H the brick arch, causing the heat to circulate in the direction of the arrows before it passes to the chimney, K. Fig. 10, a cross section of same arch.—*The Inventor has taken out a patent for his invention.*

ON THE METHOD FOR ASCERTAINING THE CHORDS OF A CIRCLE.

Gentlemen,—The great facility afforded by your Magazine to its readers, of giving information on subjects with which they may think others unacquainted, or of receiving it from those of which they themselves are ignorant, is none of the least advantages attending its publication; as by this means, the knowledge possessed by one individual is communicated to many, and this very often on subjects which he would never otherwise have thought of communicating to the public, his knowledge of the subjects having become by custom so natural to him, that he is apt to think there is none who can be unacquainted with them.

Having taken this view of the subject, I have to thank D. S. of Cupar, forthe method communicated by him (in No. CXXVIII.) for finding the chord of any arc of a circle, which method, from its general application, is superior to mine, (given in No. CVIII.) for finding the chord of $\frac{1}{4}$ or $\frac{1}{8}$ part.

It is probable, that he has not seen the request I made to him in No. CXVI. to let us know, how he finds the constant number 5.4 for a multiplier in determining the velocity of effluent water, at least, I have not yet seen any answer to it.

But having, since I made that request, seen Nicholson's Operative Mechanic, I have been led to investigate the subject, and have found 8.0216 for the constant number, instead of 5.4.

The following is the method adopted by me, for finding this number; if I am wrong I shall be glad to have my error pointed out by you, or any of your correspon-

Demonstration:—Let $h =$ the height of the head, and $v =$ the velocity to be found; also let $a =$ the space through which a heavy body falls in one second; then will $2\,a =$ the velocity it will have acquired at the end of that time. Now to find the velocity v, we have this proportion $\sqrt{a} : \sqrt{h} : v$, whence, $v\sqrt{a} = 2\,a\sqrt{h}$, or, $v = 2\,a\sqrt{\frac{h}{a}} = 2\sqrt{\frac{a^2 h}{a}} = 2\sqrt{a\,h} = 2\sqrt{a} \times \sqrt{h}$.

But according to Nicholson, the space through which a heavy body falls in a second is 16.087 feet. Therefore, if $a = 16.087$, $2\sqrt{a} \times \sqrt{h} = 2\sqrt{16.087} \times \sqrt{h} = 8.0216\sqrt{h}$: that is the square root of the head must be multiplied by 8.0216 to find the velocity of the effluent water. Or it may sometimes be more conveniently done by multiplying the head by 64.348, and taking the square root of the product.

Should these multipliers be correct, the velocity of the water, in the example given by D. S. (No. CIX.) will be 10.027, instead of 6.0372; and the ordinate of the parabola 5.314, instead of 3.199. And from the same reason, the table of the ordinates of parabolas, given by him in No. CXXVIII. will be found to be incorrect.

I have also some objections to the angle at which he lays the float-board, with which, should you think this worthy of insertion, I may, perhaps, trouble you at some future period.—I am,

Gentlemen, yours, &c.

T. A.

Galashiels, 24th June, 1826.

ENGLISH GRAMMAR—THE SUBJUNCTIVE MOOD.

Gentlemen,—There appeared in your Magazine of the 24th ult. a letter signed 'L M'L.' and addressed to me, on the subject of the Subjunctive Mood. To that letter I shall now take the liberty of adverting in a few words, not with a pretence of "shewing a deal of light upon that intricate part of Grammar," but with the hope of satisfying the mind of the Querist.

The points at which our correspondent appears to hesitate are two; What the subjunctive mood really is? and when that mood is to be used; and perhaps the abridged forms of the mood, as laid down in the generality of our grammars, may have contributed not a little to the former difficulty; while the want of uniformity in its use, as exemplified in the writings of our most celebrated English authors, may have given rise to the latter. What I therefore propose to do, is simply to give (agreeably to the opinions of Lowth, Murray, and Lennie,) a full paradigm of the subjunctive mood, in contradiction to the indicative,—and then to state the common rule which regulates the use of those moods respectively.

I. The following is a paradigm of the Subjunctive Mood, with the Indicative on the one side, in order to shew at one view the tenses in which they differ, and the tenses in which they unite. The conjunction is purposely omitted before it, as the Subjunctive Mood (in such expressions as these—"*were* there no difference, there would be no choice"—"*wert* thou wise, thou wouldest fear God")—is often found without the conjunction; besides, it is not peculiar to the Subjunctive, but may be applied without producing the least variation of person, to every tense of the potential mood:

TO LOVE.—(Active Voice.)

	Indicative Mood.	*Subjunctive Mood.*
Present Tense.———	I love, thou lovest, he loved. We love, you love, they love.	I love, thou love, he loves; We love, you love, they love.
Past Tense.———	I loved, thou lovedst, he loved; We loved, you loved, they loved.	
Perfect Tense.———	I have loved, thou hast loved, he has loved; We have loved, you have loved, they have loved.	
Pluperfect Tense.——	I had loved, thou hadst loved, he had loved; We had loved, you had loved, they had loved.	
Future Tense.———	I shall or will love, thou shalt or wilt love, he shall or will love; We shall or will love, you shall or will love, they shall or will love.	
Future Perfect Tense.——	I shall or will have loved, Thou shalt or wilt have loved, He shall or will have loved; We shall or will have loved, You shall or will have loved, They shall or will have loved.	I shall have loved, Thou shalt have loved, He shall have loved; We shall have loved, You shall have loved, They shall have loved

TO BE LOVED.—(PASSIVE VOICE.)

Indicative Mood.

Present Tense.——I am loved, thou art loved, he is loved;
We are loved, you are loved, they are loved.
Past Tense.——I was loved, thou wast loved, he was loved;
We were loved, you were loved, they were loved.

Subjunctive Mood.

I be loved, thou be loved, he be loved;
We be loved, you be loved, they be loved.
I was loved, thou wast loved, he was loved;
We were loved, you were loved, they were loved.

Perfect Tense.——I have been loved, thou hast been loved, he has been loved;
We have been loved, you have been loved, they have been loved.
Pluperfect Tense.——I had been loved, thou hadst been loved, he had been loved;
We had been loved, you had been loved, they had been loved.
Future Tense.——I shall or will be loved, thou shalt or will be loved, he shall or will be loved;
We shall or will be loved, you shall or will be loved, they shall or will be loved.

Future Perfect Tense.	I shall or will have been loved,	I shall have been loved,
	Thou shalt or wilt have been loved,	Thou shalt have been loved.
	He shall or will have been loved;	He shall have been loved;
	We shall or will have been loved,	We shall have been loved,
	You shall or will have been loved,	You shall have been loved,
	They shall or will have been loved.	They shall have been loved.

II. The rule for the regulation of these moods is: "hypothetical, conditional, concessive, and exceptive conjunctions seem in general to require the Subjunctive Mood after them, as *if*, *though*, *unless*, *except*, *whether*, *or*; but other conjunctions expressing a continuation, an addition, an inference, &c., being of a positive and absolute nature, require the Indicative, or rather leave the Mood to be determined by other circumstances and conditions of the sentence."—*Lowth.*

Or, "some Conjunctions require the Indicative, some the Subjunctive Mood, after them; it is a general rule, that when something contingent or doubtful is implied, the Subjunctive ought to be used: as, '*if I were* to write, he would not regard it;' 'he will not be pardoned, *unless* he *repent*.' Conjunctions that are of a positive and absolute nature, require the Indicative Mood, '*as virtue advances, so* vice *recedes*:' 'He is healthy, *because* he *is* temperate.'"—*Murray.*

Or, "Conjunctions that imply contingency and futurity, require the Subjunctive Mood; as, '*if* he *be* alone, give him the letter.'

"When contingency and futurity are not implied, the Indicative ought to be used; as, '*if* he speaks as he *thinks*, he may safely be trusted.'"—*Lennie.*

Let us now apply what has been premised, to the cases in hand:—And first, such expressions as "If thou *have* done thy duty: Unless he *have* brought money: If thou *had* studied more diligently: Unless thou *shall* go to-day. If thou *will* grant my request"* must, independently of any rule upon the subject, be perceived from the mere paradigm of the Subjunctive Mood to be incorrect. It is true that agreeably to the form of the verb, as laid down by Dr. Johnson† (who has so conjugated the English Sub-e from a fancied alliance per- o that of the French), these les of the Perfect Tense might me claim to propriety: but the ity of Johnson has seldom followed here,—besides it is nsistency of Lennie, and not opriety of Johnson that we are sent to indicate. Nay, the *nctive termination* of the *rfect* and *Future* Tenses, has sanctioned by some, among is the Rev. Mr. Sutcliffe,* ndertakes to support his the- reference to the Anglo-Saxon, fortunately for his cause, he ces no examples but of the *nt* Tense!

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* Lennie's Grammar, 8th Ed. page 152.

† See the Grammar prefixed to the 8vo. Ed. of Johnson's Dict.

ain, let us apply *the Rule* to xamples produced from the Scriptures:—The first exam- om Heb. viii. 8. or as the should have written, Heb. v. ndoubtedly ought to be. ugh he *was* a son,"—for no gency, or doubt is meant to pressed. The conjunction *h* is here transferred from its hetical or doubtful use, to a ng which is merely continua- and serves to introduce the ing sentence: In fact, the verse is a strange example mmatical confusion, for while rst clause ends in the point of ubjunctive Mood, the second in regard to the Indicative. ough he *were* a son, yet learn- ;" the pronoun after "learn- is expletive, for the relative)," in the preceding verse, is al nominative to the verb. The nd 8th verses ought, therefore, n thus; "*Who*, (in the days flesh, when he had offered up rs and supplication, with strong g and tears unto him that was to save from death, and was *in that he feared*;) though he *was* a son, *learned* obedience by the things which he suffered." This, in my opinion, is the proper pointing, with the parenthesis including the sentence from *who* to *though*, and not as in Leusden and Griesback including merely—*καιπερ ων ὑιος*—though he was a son.

The next example from Lev. xxvi. 6. or, as I suppose the writer meant to have said, Lev. xxii. 6. "The soul which hath touched any such shall be unclean until even, and shall not eat of the holy things, unless he *wash* his flesh with water"—as implying contingency and futurity is agreeably to the rule correct.

Gen. xxiv. 42: "If now thou *prosper* my way"—or, as the passage reads in my Bible—"If now thou do prosper my way"—is correct for the same reason.

We come next to those examples where, to use the words of our correspondent, the second and third persons are "made to speak in the *Indicative*."

The first is from 2 Cor. viii. 9: "Though he *was* rich"—which is right; as the conjunction *though* does not at all affect the verb, but only *connects* the clause with that which follow, "*yet* for your sakes he became poor.

Deut. xxviii. 15: "If thou *wilt* not hearken"—affords an example which our correspondent calls Indicative: but, he must then have forgotten the paradigm of the Subjunctive Mood as maintained by his two favourites, Lennie and Lowth!

The last example which is said to be from Matt. xviii. 2. must be from Matt. viii. 2. (Pray how is it that L. M'L. is so careless in his quotations?)† The verse is this: "and behold, there came a leper and worshipped him, saying, Lord, if

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a Grammar of the English language by the Rev. J. Sutcliffe, page 105.

r Mr. G. must blame us and the P. D. more than L. M'L. for these errors.

thou *wilt*, thou canst make me clean." The *if* is here contingent and implies futurity, it therefore requires the Subjunctive Mood. If "*wilt*" had here been an *auxiliary* verb, instead of a *principal*, the tense would have then been future, and the phrase correct; but as the sentence now runs, "*wilt*" is the present of the *principal* verb *to will* which, like all other principal verbs, receives in the Present Tense the *conjunctive termination* throughout. The verse ought therefore to be, "If thou *will* (that is *if thou be willing*) thou canst make me clean." See a similar example in Matt. xvii. 4: "If thou *wilt*, let us here make here three tabernacles"—which ought to be, "If thou *will* (ει θελεις)."—These two examples Lindley Murray has erroneously referred to as examples of the *Future Subjunctive!* §

Does our correspondent by this time perceive why hypothetical, conditional, concessive, and exceptive conjunctions seem in general *only* to require the subjunctive mood? When a conjunction which is hypothetical, conditional, concessive, or exceptive is transferred to a meaning that is continuative, additioning, or illative, then it is that that conjunction takes the indicative mood. This is the reason that "to this rule," as he expresses it, "no author that he can consult, either sacred or profane, adheres uniformly."

I think I have now answered the most of the queries of my "*pupil*;" but before I dismiss the subject, I cannot but thank the gentleman who has so obligingly put himself under my *tuition*, and as his "*dear master*," would just recommend to him, that before he meddles with the subjunctive mood, he first despatch the indicative.—I have the honour to remain, Gentlemen,

Your most obedt. Servant,

JOHN GEMMEL.

MISCELLANIES.

Tea proved to promote Health and Long Life.—Every old gossip, and every ignorant doctor, are ready on all occasions to preach against tea, as the destroyer of the nerves, and the grand enemy to health and strength. We deny it positively. We deny that tea injures either the nerves or the strength of young or old; and moreover, we can make good our denial by substantial proof, which is more, we will be bound, than the gossips and the doctors can do, though they put all their wise heads together for the purpose. Tea has undoubtedly a strong effect on the nerves, but it is the very reverse of what they so ignorantly ascribe to it; for instead of weakening and relaxing the nerves, it most powerfully braces them, and gives them tone and strength.

Recollect you not some time when *you* have been fatigued almost to fainting, and the effect which a single cup of tea has produced on you, rousing your spirits, bracing your nerves, and banishing your fatigues, as if by magic? If you have ever felt such reviving effects from tea, you will be prepared with us to give the lie direct to the vulgar error, that it hurts the nerves and weakens the body.

Nay, we go farther, and say, that the stronger it is the better for the nerves, and that it is only weak watery slops that do harm. To say with some ill-informed persons whom we could name, that tea contains no nourishment, is equally false as to say that peruvian bark or home-brewed ale is not nourishing. Tea is a strong astringent, and the longer it is infused in the tea-pot the more of the astringent matter will be drawn into the water. Now every body knows, that astringents are the most powerful tonic or strengthening medicines which we have. It is, therefore, we maintain, gross error in both principle and practice to say that tea contains no nourishment. We have a stronger proof:—

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§ Murray's 12mo. Grammar, 25th Ed. page 200.

Mary Noble, of Penrith, Cumberland, is now in the 107 year of her age, and as the intelligent Dr. Barnes informs us, tea has been her favourite food for the last 65 years!! This venerable old woman now resides with a woman aged 69, whom she nursed when a child. She is still vigorous and healthy, and has but lately used a stick to walk with. Now, what do our slanderers of tea say to this? The fact is indisputable; let them explain it if they can. On our principles, it is plain enough.

A remedy for Apoplexy.—M. Sage has lately stated in a memoir read to the National Institute at Paris, the efficacy of flour volatile alkali in cases of severe apoplexy. "For at least 40 years," says he, "I have had opportunities of witnessing the efficacy of volatile alkali, taken internally, as an immediate remedy for the apoplexy, if employed on the first appearance of the disease. One of the keepers of my cabinet, aged 72 years, robust, though thin and very sedate, was seized, while fasting, with an apoplexy. He fell down deprived of sense. When raised up, he had the rattles in his throat; his eyes were closed, his face pallid, and his teeth fixed together. I drew out his under lip so as to answer the purpose of a spout, in to which was poured a spoonful of water, containing 25 or 30 drops of flour volatile alkali. At the same time two slips of paper, the edges of which were wetted with volatile alkali, were introduced into his nostrils. The teeth were speedily separated, and the eyes opened. A second dose of alkali was instantly poured down the throat. The rattles ceased; speech and recollection returned. In the course of an hour the patient recovered sufficiently to proceed without assistance about 300 paces to his own chamber. In another hour he got up, asked for something to eat, and has since experienced no return of the disorder." He reports another instance in the person of one of his friends, who was a great eater, and was struck with the apoplexy while at table. "The volatile alkali excited a vomiting; and after that had abated, the patient took 20 drops of volatile alkali in half a glass of wine. His senses returned, and in two hours he was able to walk in his garden."

Analogy between Man and the Brute Creation.—It is not by simply attending to the more intricate actions of the lower animals, that we alone discover signs of an intellectual principle more independant in its operation than the law of instinct; we must ascend yet higher: let us reflect on the passions and feelings which supply motives to such actions, and we shall then be sensible of a closer analogy between men and the brutes, than the pride of many of the former, perhaps, will suffer them to acknowledge. Observe a Newfoundland dog plunge into the water, and, seizing the hair of his drowning master, draw him in safety to the shore. Look at a terrier guarding for three months the remains of his benefactor, his friend and companion, who perished on a mountain. Shall we say that these animals acted merely from instinct? from no other cause than a certain blind impulse, and without any view to consequences? Shall we assert that Providence had so organized their frames, had so subjected them to the mysterious uncontrollable influence of a certain law, that they could not have acted otherwise? Will the warmest advocate for the superiority of his species deny, that the dog in thefirst instance felt as deeply, reasoned as acutely, and acted as wisely, as he himself could have done? When the little terrier lost his master, is it fanciful to suppose that his mind dwelt with gratitude on the remembrance of a benefactor who had so often fed, so tenderly caressed him?—No:—he doubtless recalled to his recollection a thousand acts of kindness; at the expiration of three months he was still watching his remains:—and did not this creature display as much sensibility and real feeling as half our species would have done at the loss of such a friend? Was it chained to the spot by the mechanism of a clock-work principle? No, no: let us acknowledge that other animals are sometimes as intelligent as ourselves;—let us adore the Creator of the universe, who, in giving to brutes an intellectual principle capable of memory, volition, and possessing in a limited degree the faculty of reasoning, has not only provided for their immediate wants, but graciously multiplied their means of happiness. It is natural to suppose that the lower animals enjoy from their cogitations a very high degree of pleasure. A beast, a bird of prey, reposing in the solitary gloom of a deep forest, when not actually sleeping, enjoys a positive happiness, from the recollection of their last meal; from the anticipation of another; or in forming vague plans for surprising their next prey, when hunger shall impel them to persue it. A little bird confined in a cage, and supplied with a sufficiency of food, is happy either in motion, or when sitting on its perch; it observes the actions of others, or gives itself up to a succession of confused ideas, of which perhaps it is scarcely sensible, and which leave not a trace behind. If we will not allow that brutes ever think; if we suppose them incapable of a single idea, however simple, it must certainly follow, that they are mere automatons, moved by mechanism: but if, as appears evident, they are capable of thought, it is equally clear that they must have a soul; for thought is an act of the mind, and mind (though as a substantive it is a word which sometimes expresses a power or faculty of the soul) in its largest sense is synonymous with soul.

Case of local Self-Combustion. Abridged from the Journal of the Hamburg Hospital.—F. M. C. Heins, of delicate constitution and florid complexion, had for some time past been affected with pain of the head and giddiness to such a degree, that she was compelled to give up her employment as housemaid, and apply herself to something which required less exertion, as that of sewing. On the 21st of January 1825, as she was occupied in sewing, she felt an extraordinary sensation of heat all through the body, and in the fore-finger of the left hand a violent burning sensation; at the same instant there proceeded from the same finger a blue flame, about an inch and a half long, which emitted a peculiar sulphureous smell. The flame could not be extinguished, either with water, or by means of a wet towel put round the finger. On putting the hand into water, the whole hand appeared on fire. The patient went, in a great hurry, from the house in which she was at work to her home, and wrapped the hand in her apron, this, together with her clothes, was considerably burnt, but still the flame was only perceptible in the dark. On her return home, she dipped her hand in milk, and continued this during the night, by which means the flame was extinguished; the burning heat in the left hand, together with the occasional emission of the sulphureous smell, continued. After a venesection, and the use of some medicines, the patient got better, but she always retained a burning sensation in the left fore-arm, which, very often, emitted a smell like that of sulphur.

On the 25th of February she was admitted into the hospital. The internal surface of the middle of the hand was at this time covered with small bladders, and on one or two of the fingers there was the same appearance. Friction with wool produced in the fore-finger a sensation of burning. The appetite was slight; the thirst considerable; pulse tranquil, and, independant of pain in the fore-part of the head, there was no mark of a disordered state of body. In the night of the 26th and 27th the patient slept well; the bladders did not spread any farther, but the sensation of heat still continued in the left hand, and the motion of the volar surface and the fingers occasioned great pain. In this hand the thermometer was at 87° Fahr., but in the other hand, on the contrary, only at 70. Several experiments were made with different combustible substances, which however, shewed nothing worthy of notice. Also the best electrometers remained unacted upon, whilst the patient was placed on the insolated stool. Bad taste in the mouth, and a bad appetite were now the only symptoms of a deranged state of health.

Electric sparks were drawn from the points of the finger of the left hand, which, however, caused the patient great pain. On the following day, the burning shewed itself in the points of the fingers of the same hand, particularly in the fore-finger, much stronger than before. No fresh bladders made their appearance. Between this and the 5th of May, she remained just in this state; the increase of temperature in the left hand still continued, with the sensation of heat, and occasional burning. In other respects the girl was healthy, and, feeling a desire to resume her avocations, she was discharged. This is the simple observation of a most remarkable case, which in reference to the absence of the usual circumstances in self-combustion, particularly *non*-destruction of the affected part, is the only one of the kind yet known. In the only analogous case, is a man where the arm was but partially attacked with fire, so that he could call persons to his assistance, and show them the phenomenon, there was all of a sudden pain in the arm, like that from the blow of a stick, and, at the same time, he observed a spark which burnt the shirt to ashes.—*Hecker's Annalen.*

Uses of the Mustachial Bristles of Cats.—Mr. Vroolick, a philosopher of Amsterdam, has recently ascertained by satisfactory experiments, that the mustachial bristles about the mouth and eyes of cats, rabbits, &c. are peculiar organs of touch, designed to guide them in the dark, when they can make no use of their eyes. We believe it is commonly supposed that they are connected with the sense of smelling. This appears in the London papers; though we certainly do not look on the Dutchman's discovery as particularly wonderful; for it is common in this country to call the bristles alluded to by the name of feelers.

French Institute.—The Institute of France held its annual meeting of the four Academies. Messrs. Cuvier and M. de la Malle were the only two members who distinguished themselves. The latter is the son of the celebrated author of the same name, who has given the excellent translations of Tacitus and Sallust. The son's genius seems to be of a lighter order; he published Travels in the Alps, some fugitive Poetry, and a highly curious Memoir, in which he proves that the Roman guides have for ages mistaken the position of the Tarpean Rock. He discovered its precise situation, hidden as it is by buildings in front of it. His *Poliorcetique*, or art of war amongst the Ancients, changed public opinion in his favour: the work is full of curious researches, in which he has made the knowledge of natural history serve to ascertain very important points in the history of ancient wars. The triumphs were often sculptured on the walls of the city or palace of the conqueror. The artists frequently, to designate the people, sculptured a tree or a plant peculiar to the country; and M. D. de la M. is, we believe, the first who availed himself of this fact, to penetrate into the labyrinth of events anterior to this period of history. The discourse lately pronounced, is extracted from a work he is preparing for the press, on the population and products of Italy, from the remotest periods to the present time.

Academy of Sciences.—The French Academy of Sciences, having last year proposed as a prize subject, to determine, by a series of chemical physiological experiments, what are the phenomena which succeeded one another in the digestion, granted to Messrs. Leuret and Lesseige the sum of 1,500 francs, in consideration of the numerous and expensive experiments made by them, and of the remarkable results obtained. The principal conclusion to be drawn from the researches of these gentlemen is, that digestion, in warm-blooded animals, consists in the transformation of the food into organical or chyleous molecules, after it has been diluted and divided to infinity by the juices of the intestinal canal. These molecules, of a globulous shape, they consider analogous to monads, or microscopic animalcula of the simplest kind. In support of this supposition they adduce the great quantity of these animalcula which are found in the intestines of frogs, and which they also regard as the produce of digestion. If, on the one hand, it may be objected to them that the stagnant water, which these reptiles inhabit, contain numbers of these minute beings, which they may probably swallow, it must on the other hand be acknowledged, that learned naturalists have expressed a similiar opinion, and have considered these animalcula, as being rather the elementary molecules of animals, and perhaps of vegetables, than real animals. In order to shew their sense of the obstacles in the way of the complete solution of the question proposed by the Academy, Messrs. Leuret and Lasseige conclude their memoir as follows: "It is impossible, in the existing state of knowledge, to determine the chemical alterations which food undergoes in the digestive canal, because the means of analysis are insufficient, and because the mixture of the food with the juices in the digestive canal, renders the results of any experiment exceedingly complicated."

On the construction of the Heavens.—In a paper on this subject read before the Royal Society, Sir W. Herschel enumerates a great diversity of parts that enter into the construction of the heavens. The first species are insulated stars; as such the author considers our sun, and all the brightest stars, which he supposes nearly out of the reach of mutual gravitation; for, stating the annual parallax of Sirius at 1″, he calculates that Sirius and the sun, if left alone, would be 33 millions of years in falling together; and that the action of the stars of the milky way, as well as others, would tend to protract this time much more. Herschel conjectures that insulated stars alone are surrounded by planets. The next are binary sidereal systems, or double stars; from the great number of these which are visible in different parts of the heavens, and the frequent apparent equality of the two stars, Herschel calculates the very great improbability that they should be at distances from each other at all comparable to those of the insulated stars; hence he infers, that they must be subjected to mutual gravitation, and can only preserve their relative distances by a periodical revolution round a common centre. In confirmation of this inference, he states that many double stars have actually changed their situation in a progressive course, the motion of some being direct, and of others retrograde. The proper motion of our sun does not appear to be of this kind, but to be rather the effect of some perturbations in the neighbouring systems. The same theory is next applied to triple, quadruple, and multiple systems of stars, and particular hypothetical cases are explained by diagrams. Some such cases, Herschel is fully persuaded, have a real existence in nature. The fourth species consists of clustering stars, and of the milky way; the stars thus disposed constitute masses, which appear brighter in the middle, and fainter towards the extremities, being perhaps collected in a spherical form. Groups of stars the author distinguishes from these by a want of apparent condensation about a centre of attraction; and clusters of stars, by a much more complete compression near such a centre, so as to exhibit a mottled lustre, almost resembling a nucleus. The eighth species consists of nebulæ, which probably differ from the three last species only in being much more remote; some of them, Herschel calculates, must be at so great a distance, that the rays of light must have been nearly two millions of years in travelling from them to our system. The stellar nebulæ, or stars with burs, form a distinct species. A milky nebulosity is next mentioned, which may in some cases resemble other nebulæ, but in others appear to be diffused, almost like a fluid: the author is not inclined to consider it as either resembling the zodiacal light of the sun, or of a phosphorescent nature. The tenth species is denominated nebulous stars; these are stars surrounded with a nebulosity like an atmosphere, of which the magnitude must be amazingly great; for the apparent diameter of one of them, described in the catalogue, was 3′. The planetary nebulœ are distinguished by their equable brightness, and circular form, while their light is still too faint to be produced by a single luminary of great dimensions. When they have bright central points, Herschel considers them as forming a twelfth species, and supposes them to be allied to the nebulous stars, which might approach to there nature, if their luminous atmospheres were very much condensed round the nucleus.

The following is a correct copy of Mr. Cook's letter, into which an error crept in our former insertion of it.

"To the Publisher of the Glasgow Mechanic's Magazine, Glasgow.

Tradeston, Glasgow, 20th May, 1826.

"SIR,—It gives me great pleasure to certify, that the very elegant specimen of work sent in competition for your Fifth Prize, being a very complete and highly finished Working Model of a Steam Engine, constructed and finished entirely by Mr. Thomas Addison Barnes, a native of Ireland, and is, at present, serving in his third year of apprenticeship in our establishment here—I am, SIR, your most obedient servant,

JAMES COOK."

Published every Saturday, by W. R. M'PHUN, 86, Trongate, Glasgow, to whom Communications (post paid) must be addressed.

AITKEN, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE,

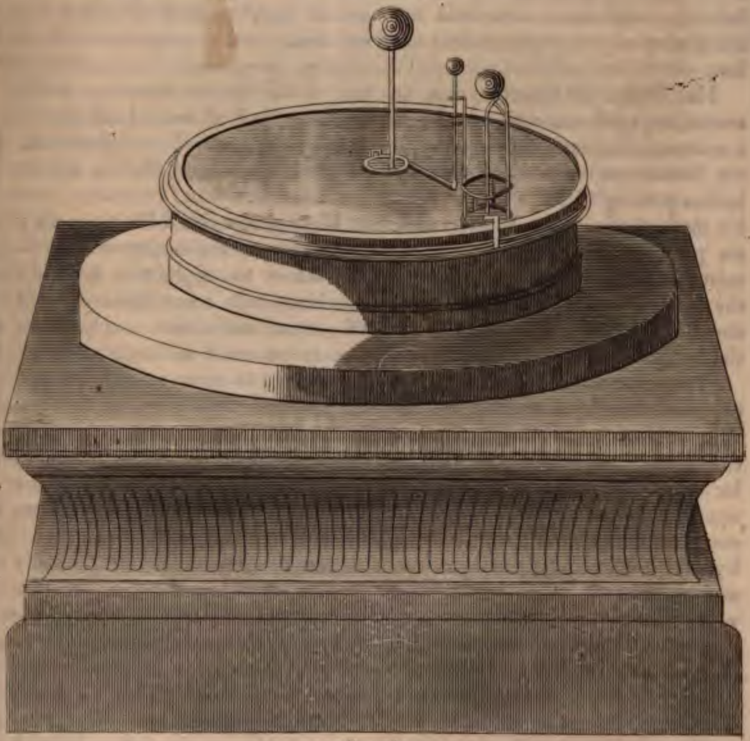
CONDUCTED BY

A Committee of Civil Engineers and Practical Mechanics.

"Ignorance when it is voluntary is criminal: and he may properly be charged with evil who refused to learn how he might prevent it."—*Johnson.*

No. CXXXV. *Saturday*, 22d *July*, 1826. Price 3d.

THE SELF-MOVING ORRERY, INVENTED BY Dr. BUSBY.



—Swan Sc—

SELF-MOVING ORRERY.—Invented by Dr. Busby.

The Busby Orrery, unquestionably the most beautiful contrivance of modern times, for the popular exhibition of Astronomical phenomena, ranks high as well for its mechanical merit as its singular beauty of action: it is properly termed a self-acting machine, and, to the eye of taste, is equally charming in its conception, its organization, and its effect. The self-acting Hydraulic Orrery seems, indeed, to lay open a new field for the display of philosophical mechanism.

Mr. Busby, its inventor, was, it seems, engaged, some time back, in a series of experiments to determine the resistances opposed to floating bodies passing through fluids; and his method of performing these will, we presume, be interesting to our scientific readers, both as it led to the invention of the machine we are about to describe, and as it exhibits the rationale of its construction.

A circular reservoir of water was provided, having a small perpendicular shaft erected in the centre, and the vessel which formed the particular subject of experiment was placed upon the water, near the circumference, but connected with the centre, by an arbor extending to the shaft, and supported by a float. The vessel was pierced in the bottom, and the shorter extremity of a syphon being soldered into the opening, the longer leg hung over the circumference of the reservoir. This leg, unlike that of the ordinary syphon, was closed at the bottom, but a small lateral aperture being made, the water spouted through it, in a direction at right angles to the arbor, and the vessel immediately began to move with accelerated velocity in an opposite course: in a second or two it arrived at a maximum, and the future progress exhibited that delightful, equable, gliding motion, which seems to afford the only true similitude to the silent grandeur of the celestial movements.

The principle upon which this experiment was made, is that of the well-known philosophical machine called "Barker's Mill;" but the grand improvement consisted in combining that principle with a syphon, supported by a floating body; by which means a perfectly uniform head of water (and consequently of action) was preserved, and the mechanical friction almost annihilated.

Having completed his temporary experiments, the author next endeavoured to apply this beautiful combination to some other purpose of general usefulness; and it immediately occurred to him, that an Orrery might be so constructed upon hydraulic principles, as, by their instrumentality, to afford a more perfect and accurate representation of the harmonious movement of the heavenly bodies, than had yet been effected.

Orreries are now too generally known to be otherwise than familiar to every well-informed person: these instruments, however, have hitherto been constructed by a complication of wheel-work, which, although extremely ingenious, are nevertheless altogether unequal to the imitation of these equable, silent, and undeviating movements which characterize the grandest works of the Creator. The Hydraulic Orrery, on the contrary, possesses all the advantages of the former machines, together with the distinguishing characteristic of self-action, and a perfect imitation of the motions, as well as the position of the planetary bodies. It will be recollected, that to constitute an orrery, it is not necessary that the machine should include all the planets: a machine, which represents the motions of the sun, the earth, and the moon, is still an orrery; and to these bodies, with Jupiter and his satellites, Mr. Busby first applied his Hydraulic principles. It appears, however, he has recently arranged and organized a plan for a more extensive Hydraulic Orrery, in which the most remote planets and their satellites are included.

In the centre of his exhibition-room was placed a circular reservoir, five feet diameter, the Sun, represented by a ball of nine inches diameter, sustained upon a slender shaft, about two feet above the surface of the water, and borne by a small circular floating vessel in the middle of the reservoir: this vessel carried a syphon, which discharged a minute lateral stream into a separate floating rim, or concentric circular vessel, which surrounds it. The re-action of this discharge causes the vessel bearing the Sun to revolve upon an axis erected in the centre of a bar, extended diametrically across the inner circle of the rim, or surrounding vessel. The water thus received into the rim flows along a tube beneath the surface of a reservoir, and enters a floating cylindrical chamber at the other extremity. In the centre of this chamber a tube is erected, through which a forked rod passes, and bears the Earth, represented by a ball of three inches diameter, at an appropriate elevation, and having its axis duly inclined to the ecliptic. A separate floating rim surrounds the cylindrical chamber, bearing the shaft which carries the Moon on one side, and a re-acting syphon on the other, the discharge from which impels it round the shaft which bears the Earth. This floating rim also acts, by contact, upon a small wheel, attached to a slender rod, communicating by an universal joint with the axis of the earth, and thus causes that body to revolve; while the action of a vertical wheel, with a radiating axis rolling round a horizontal circle fixed to the rod sustaining the Earth, gives motion to a small crank, which imparts an ascending and descending motion to the Moon, and produces the obliquity of its orbit; and a calculated disparity between the diameters of the vertical wheel, and the circle upon which it rolls, causes these ascending and descending motions to take place in a less period than one revolution of the Moon, and thus gives the due changes of the nodes.

The shaft which bears the Earth is continued beneath the surface of the water, and a flat plate of six inches diameter, is connected with a plate of equal diameter at the circumference, by three parallel and oblique rods extending to it at the bottom of the centre of the reservoir, thus preserving the parallelism of the Earth's axis, on a principle analogous to that of a parallel ruler, at the same time the lateral motion of the central vessel, bearing the Sun, is prevented by a spur, which embraces the circumference of the plate beneath.

But as the water which is discharged by the syphons already described, would soon fill the receptacles, the operation of a third syphon is introduced, which carries away the superfluous water, and by its lateral discharge on the outside the general reservoir, gives the annual motion of the Earth and Moon about the Sun.

We have thus attempted to describe the construction of this beautiful machine, but mere description does but imperfectly convey an idea of its effect in action. Our plate correctly represents its appearance on an enlarged scale, and (on a design of our own) under circumstances which, in actual construction, would render it of delightful interest; but its evolutions must be seen to be understood, its novelty and beauty of action felt and appreciated.

In another part of the room an ingenious apparatus represented the planet Jupiter and his satellites. In this the planet is centrally supported on a circular floating vessel, and the satellites are borne by concentric floating vessels at their due distances, respectively, from the primary. The primary receives its motion by the action of a stream of rarefied air, which proceed from the flame of a small lamp, and acting against an inclined shade or sail, is thrown out in an horizontal direction. Thus the circular vessel bearing Jupiter, is made to revolve; the motion of this vessel imparts a gyratory motion to the whole body of water, by transmission from the several concentric vessels; and the vessels bearing the satellites, are consequently made to revolve by the action of the water itself, with velocities regularly diminishing as their distances from the primary increase.

The Hydraulic Orrery, its inventor has justly observed, may be erected on the most extensive scale, on a natural or artificial basin in the open air, or would form an interesting appendage to a conservatory or aquarium; but, as their exists no practical obstruction to the erection of these beautiful orreries on the great scale, *we venture to recommend them as suitable ornaments for all public places, in which a suitable piece of water occupies a commanding site. And we are decidedly of opinion, that an arrangement of this self-acting machinery, in any such situation, would do more to promote a love of science and general astronomical information, than any thing that has been yet effected with that intention.*

RYLAND'S LIVING ORRERY.

THE singular beauty and attractive simplicity of the Busby Orrery, and the unlimited scale on which it may be practically employed, is approached (it is certainly not equalled) by a contrivance for a popular exhibition of the planetary system, by John Ryland, in his elementary treatise of Mechanics, in the year 1768. And a more extensive and more perfectly organized arrangement, by De Vaux, announced in his treatise on the Longitude—Ryland's description is simple and concise; he designates his arrangement as "a living orrery, made with sixteen school-boys." And, speaking of astronomy as a science capable of popular illustration, he says:—

"It may be taught them in their play-hours with as much pleasure as they learn to play at marbles, or drive a hoop for an hour or two; and this may be done in the following manner:

"Take sixteen blank cards; write on one, the Sun; a seventeenth boy of a large size must be used for the Sun in the centre, with his diameter, which is seven hundred thousand miles. On another card write Mercury, with his period, eighty-eight days, distance from the Sun thirty-two millions, diameter two thousand six hundred miles, and hourly motion, which is one hundred thousand miles. So go on to Venus, our Earth, Mars, Jupiter, and Saturn. Then write on your other cards the names and periods of the ten moons in our system. Having thus furnished your cards, then provide the orbits for these sham planets; go into any plain field or place, where boys can play; draw a circle of two hundred feet diameter, which you may easily do with a cord and Broomstick, ordering one boy to hold the cord in the centre, while you describe the circle with the stick at the other end of the string. When you have formed your circle, divide the semi-diameter into a hundred parts; if you choose exactness, take five of these parts from the centre, and describe a circle for Mercury's orbit; take seven parts for the orbit of Venus; ten parts for our Earth's orbit; fifteen parts for the orbit of Mars; fifty-two parts, that is fifty-two feet, for the orbit of Jupiter. And let the outward circle of a hundred feet represent the orbit of Saturn, which is the boundary of the Newtonian system. After this draw your circles for our Moon round the Earth, for Jupiter's moons round him, and last of all for Saturn's five moons. There is no occasion to be scrupulously exact till the boys are well versed in these first easy notions; reduce them to accuracy by degrees. Whiston's Astronomical Principles of Religion and Ferguson's Astronomy will furnish ample materials for all your purposes. Now begin your play, fix your boys in their circles, each with his card in his hand, and then put your orrery in motion, giving each boy a direction to move from west to east, Mercury to move swiftest, and the others in proportion to their distances, and each boy repeating in his turn, the contents of his card, concerning his *distance, magnitude, period,* and *hourly motion.* Half an hour spent in this play once-a-week will, in the compass of a year, fix such clear and sure ideas of the solar system, as they can never forget to the last hour of life; and will probably rouse sparks of genius, which will kindle into a bright and beautiful flame in the manly part of life.

DE VAUX'S MILITARY ORRERY.

DE VAUX's arrangement is evidently built on, and was in all probability suggested, by Ryland's method. Of its ingenuity, and its excellence of practical effect, we cannot doubt, but its originality, after the proposal of our countryman Ryland, we are bound to question. De Vaux thus describes his method:—

"Let us suppose that you have a pleasure-ground in the Isle of Wight, containing a large grass-plot about 400 feet diameter, with a southern aspect towards the bay of St. Helena's, forming a declivity of 23½ degrees from the centre. In this centre should be a round pavilion, having a sky-light and windows all round. This pavilion will be our observatory, and at the same time will represent the Sun in the middle of our planetary system. As this pavilion must contain company and music, &c. it must be at least 20 feet diameter; which diameter representing that of the Sun, and the distance of the earth from the Sun, being about 100 of his diameter, if we intended to place the Earth at its true distance from the Sun, relative to its diameter, then the Earth's place or orbit would be 2,000 feet from the Sun, and the diameter of the Earth in this hypothesis would be only 2-12ths inches; and consequently the superior planets would be, in proportion, at a distance too considerable for our object; but if we keep that proportion two 2-12ths inches for the diameter of the Earth, and if we follow the same for all the other planets, we shall have Mercury 2-10ths of an inch, Venus 2 inches, the Earth two 2-12th inches, Mars one 2-12ths inches, Jupiter 2 feet, Saturn 1 foot 8 inches, and Georgium 10 inches.

"As to the distances of each planet from the Sun (which is the semi-diameter of each of their orbits.), if we adopt their proportional distances, as in the last line of the above table, we shall have Mercury 4 feet, Venus 7, the Earth 10, Mars 15, Jupiter 52, Saturn 95, and Georgium 190 feet distance from their centre, the Sun, that is to say, from our pavilion.

"Now, let us trace our planisphere, as it should be done before the building of the pavilion. For this purpose, take a cord, at least 190 feet long, tie a peg at each end; fix one of these pegs at the centre point; deduce 10 feet for the semi-diameter of the pavilion; then, at 190 feet farther, trace with the other peg a circle, which will be the orbit of the remotest planet Georgium. Double the cord in two, and at 95 feet from the surface of the pavilion's place, you will have the orbit of Saturn to trace there. At the distance of 52 feet from the pavilion, you will trace the orbit of Jupiter; at 15 feet, that of Mars; that of the Earth at 10 feet; of Venus at 7; and of Mercury at 4 feet, from the outside of the pavilion. Each of these circular lines must be the middle of a gravel-walk, which will be the tract of each planet. It would not occasion a great deal more trouble to turn these *circles* into ellipses; but as these *orbits, except* that of Mercury, have *little eccentricity*, and have different nodes, which change situations every year, though very slowly, we must content ourselves in determining the ellipsis of the earth. The eccentricity of this orbit is the sixtieth part of the diameter of that orbit. As we have given to this diameter 20 feet, the sixtieth part of it is four inches. Then we shall trace the elliptic orbit of the earth, as usual, by ellipse figure; but in such a manner, that the north point of it shall be four inches near the Sun, and the other extremity of that diameter eight inches farther. This diameter is called the apsides. The other shorter diameter which crosses this one from east to west, is the equinoxial, and will be four inches less than the other diameter.

"Now that we have fixed the proportion of each planet in diameter (consequently in bulk), and of the distances in our planisphere, we will represent them with globular transparencies; each of these transparencies elevated to about four feet from the ground, but more or less according to their different inclinations relatively to the Earth. The Sun itself will be a collection of reflectors, or a focus of the most brilliant light possible, and the pavilion will be erected over it, being supported by light pillars, in order that the spectators or observers in the pavilion may see better the effect of the whole; which they could not, if their eyes were struck with lights.

"Each of the globular transparencies of the planets will be the head of some sort of god or goddess, such as Mercury, Venus, Mars, Jupiter, Saturn, and his most gracious majesty, sitting in little cars; which cars will be directed from west to east, and drawn by seven soldiers or other men accustomed to march in measure.

"I should have said that each of

these transparencies will not be only of different bulks, but also of different degrees of brightness, or apparent colour, according to their distances, or their natural aspect; and besides, on the opposite side of the Sun, a dark hemisphere must be adapted to each planet. By this means each planet can be made to have a diurnal rotation in that dark hemisphere. It will have this advantage also, that any spectator placed near the Earth (that is to say geocentrically,) or near some other planets, will be able to see the different phases, even of the Earth, which will be very curious; because all these effects which require so much observation and study, will be produced at once, and in a short time, though proportionally as exact as can be expected of an artificial-experiment.

"To put this planetary system in motion at pleasure, you have only to give your order, to make a signal, or to say, 'march!' then the music beginning to play a march, and each soldier making his step in measure, the planets will execute their revolution in due time relatively one to the other; that is to say, the nearest to the Sun will make as many revolutions as they do in the sky during the great revolutions of the superior ones.

"For this effect, if the musicians regulate each measure to be in two seconds in time, the soldiers will also make each of their steps in two seconds; then each soldier holding the pole of his car with the right hand, and marching on the border of his path, the extent of his steps will be regulated by as many short sticks lying flat on the side of the gravel, but not in the way of the car, and upon which stick the soldiers will place the middle of their feet at each step; so that if the orbit of Georgium, the farthest planet, is walked over in eighty minutes, (each step of the soldier being only six inches,) and the orbit of the earth (which is only thirty steps of two feet, or sixty seconds in time,) in one minute, the Earth will make eighty revolutions during one of the Georgium, which is conformable to nature, and so on in proportion with all the others.

"In the space then of one hour and twenty minutes, you will be able to make a whole treatise of practical astronomy."

Some useful appendages to the orrery are described after this, which are, however, of minor importance, and would occupy too much space to insert. The nearest fixed star is to be represented by a light in a ship at anchor fifteen miles from the pavilion; and the various motions of the moon are to be exhibited by some wheel-work added to the inside of the car of the Earth (or Tellus) and connected with the wheels of this car, "which will give a circular motion to a little globe representing the Moon;" and the other planets may be furnished with satellites in the same manner. The author has not even forgotten the Comets; he mentions that "some small rockets fired from the pavilion in an oblique direction would imitate pretty well the effects of the Comets, and would not diminish the gaiety of the astronomical experiments."

ESSAYS ON BLEACHING.

BY JAMES RENNIE, A. M. LECTURER ON PHILOSOPHY, &c. &c. LONDON.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

SECTION V.

11. *Steam Bleaching.*—The compressed steam of boiling alkaline leys, was, some time ago, recommended for the purposes of bleaching, by Chaptal, (*Chim. app. aux. Arts* III. 100, and *Journ. de Physique pour* 1801): chiefly for cotton goods. They are continuedly and repeatedly immersed in an alkaline ley, made in the usual manner, and then exposed to the action of the vapour arising from the same ley, heated to 220° or 230° Fahr. By this means the French chemists Chaptal and Delametherie procured good whites, without injury to the fabric of the cloth, and without useing any preparation of Chlorine. They found that the resinous, and other colouring matters of the cloth, which are insoluble in a diluted ley of the temperature of boiling water, becomes soluble in the vapour of the same, when the heat is carried a few degrees farther. The immersion of the goods in the ley, and subsequent exposure to its vapour, are successively repeated, till the goods become completely white. Chaptal performed an extensive experiment on the same principle, in order to introduce it for domestic washing, (*see Ann. de Chim.* xxxviii. 291.) He washed by this method, with great success, 200 pairs of sheets belonging to the Hotel Dieu at Paris. In giving an account of this Mr. Parkes observes, that brown calicoes, which have only been *once* boiled, after having been all night in the whale-boiler, *are often completely* white, where *they have been in immediate* contact with the iron in the midst of the apparatus, while the other parts were almost unchanged. The process of steam bleaching, the same author remarks, will always be attended with danger, as the force of the steam, if the valves be overloaded, or deranged, may burst the apparatus. It seems to be but a slight modification of the French process, for which Mr Turnbull of Bonhill has lately obtained a patent. (*See Repository of Arts.*) He immerses his goods, either cotton or linen, in a hot solution of caustic alkali, and then exposes them to the vapour of simple water, when loaded with the alkali in which they have been immersed. The previous and subsequent processes are the same as in the ordinary mode, and the chief advantage of this plan seems to be in the saving of alkali, much fewer baths of ley being necessary than in the common method, as the heated vapour increases the alkaline action. It does not however supersede the Chlorine preparations, at least, good whites cannot *easily* be procured without one immersion in an oxymuriate. Slabs of stone, cramped with iron, are found the best apparatus for steam bleaching. More information on this subject may be had in *D'Orellie, Essais sur le Blanchiment.* M. Cadet thinks that the rationale of this process consists in the alkali exercising over the oil, or resin of the cloth, a double attraction: first, direct with the constituent principles of the oil, and secondly, predisposing and favouring the combination of the oxy-

f the atmosphere, with the ous or resinous matters. This s, he thinks, from the oil of eing decomposed by an acid, always more concrete, and oxyginated than it was before. *de Chim*. No. 131.)

Paper Bleaching.—The title I have chosen for this section, ehends two different processes: r bleaching rags, and other als from which paper is at bricated, and another for re- ting paper from old written inted papers. We are chiefly ed to the French chemists for processes, which may be seen ious parts of the Annales de e, and in des Charme's Art of aching. Rags, when grey or ed, are to be separated and d in the Paper-mill in the way, till brought to a sort of m consistence, having been usly macerated according to quantity and tenacity. The is then treated with an alkaline milar to what has already been ed for piece goods. It is treated with any of the pre- ons of Chlorine, which is ht most convenient. I believe xymuriate of pot-ash, which ately the most common, has given place in Britain to the uriate of lime. If this immer- lo not produce the desired ef- which does not often happen colours are tenacious, such as d blue, let the treatment with lkaline leys be repeated, and it with another bath of the ne preparation. Then sour hole in a bath of sulphuric much diluted, and cold, for hot, its action will be less ef- l. Water is then to be run it till it come off *without col- indication of acidity*. Black *most easily discharged colour, seldom require being* treated with ley or steep of sulphuric acid, and another of oxymuriate of lime being commonly sufficient to produce a good white. The mass is then ready for being manufactured; and in this manner may be bleached at a trifling expense, and in a few hours, a sufficient quantity of materials for making as much paper as will print a large edition of the largest work in the English language. Old printed or written paper again is first to be sorted according to its quality, and all the yellow edges cut off by the Bookbinder's plane. A cwt. of this paper is to be put sheet by sheet into vats sufficiently capacious, with 500 quarts of hot water. The whole is to be stirred for about an hour, and as much water gradually added as will rise about three inches above the paper, and to be left to macerate for four or five hours. It is then ground coarsely in the mill, and boiled in water for about an hour, taking care to add before it begins to boil, thirteen quarts of caustic alkaline ley. After boiling, it is macerated in the ley for twelve hours, when it is pressed, and if sufficiently white, is forthwith manufactured into paper, if not, the process is repeated. Written paper may be bleached by sulphuric acid alone, and printed paper by alkaline or soap leys, but the above process is the most effectual, and the expense is exceedingly trifling. Paper which has been written or printed may even be bleached without destroying the leaves, by treating them with the same chemical agents, taking care to arrange the sheets alternately between cloths in the same manner as the paper makers dispose their sheets of paper when delivered from the form. (*See* Chaptal, Chim. app. *aux. Arts* III. 108, and Ann. de *Chim*. I. 69.)

LETTERS AND QUERIES.

TO THE EDITORS OF THE GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—I, as one of the Proprietors of Stock in this concern, received a copy of the following, which, as it may prove not only interesting to your readers generally, but highly important to the Proprietors, I have submitted it to you, and will feel obliged by your inserting it in your valuable little Periodical.—I am, Gentlemen,

Yours, respectfully,

A CONSTANT READER.

TO THE COMPANY OF PROPRIETORS OF THE CRANSTONHILL WATER WORKS.

LADIES AND GENTLEMEN,—The Circular Letter extracted from the Minutes of the Committee of Management, of date 20th April, 1826, actually shews that Public confidence is totally lost, when the Company's wants urge them to expose for sale L.25 Shares at the low price of L.7 : 10s. It must astonish every Proprietor of Stock in the Works, to learn that the Committee, a few months ago, stopped the sale of Shares when they were selling at L.9 : 14 : 6d. and are now offering them at the above named price of L.7 : 10s. and at the same time holding out to the Proprietors that the affairs of the Company are in a prosperous state.

I (as a Proprietor of Stock) beg leave to lay before you an Abstract view of the Funds, as taken from the Annual Reports of the two Water Companies in this City for the last five years; and this I do in the full hope that the General Proprietors present at the General Assembly, to be held on the 15th June, will not rashly agree to any speculations similiar to those practised for the last eighteen years, without duly considering the effects that may be produced, endeavouring to find out where the error lies, and, if possible, to find a remedy for the evil, so generally and so very justly complained of.

Abstract from the Annual Reports of the Glasgow Water Works Company for the last five years.

Dates.	Gross Amount of Stock.			Total Annual Expenditure.			Total Annual Revenue.			Amount of Dividends on each £50 Share.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s	d.
1822	134,357	1	5	2,928	11	7	9,626	19	8	3	—	—
1823	135,931	6	7	2,817	5	—	10,081	6	11	3	—	—
1824	139,458	3	2	2,604	8	4	10,502	4	10	3	5	—
1825	143,833	11	—	2,573	7	10	11,954	10	[illegible]	3	15	—
1826	146,485	11	5	3,549	11	6	12,483	3	[illegible]	5	15	—

Abstract from the Annual Reports of the Cranstonhill Water Works Company for the last five years.

Dates.	Gross Amount of Stock.			Total Annual Expenditure.			Total Annual Revenue.			Amount of Dividends on each Share of £25.			Lost upholding the Works above the Revenue.			Total loss of Interest on stock.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1822	116,355	11	8	3,170	7	0½	1,333	19	8	—	—	—	1,836	7	4½	5,817	—	—
1823	121,495	16	2	3,804	7	8½	1,890	10	7	—	—	—	1,913	17	1½	6,074	—	—
1824	140,569	11	9	3,001	7	5	2,270	1	2	—	—	—	731	6	3	7,028	—	—
1825	141,218	11	0	3,374	15	9½	2,700	16	4	—	—	—	637	19	5½	7,061	—	—
1826	142,360	8	7½	3,485	5	4	4,003	13	9	—	2	2	—	—	—	6,600	—	—
													5,119	10	2½	32,580	0	0

Total Loss on Interest, 5 years,	£32,580	0	0
Upholding Works, 4 —	5,119	10	2¼
Increase of Stock in 5 —	26,004	16	11½
Supposed increase of Stock,	£63,704	7	2

In looking over the above Abstracts, it must give pleasure to every Proprietor to observe, that there has been an increase in the Annual Revenue for the last five years; but will any Gentleman, after comparing the Abstracts of the two Companies, (as above stated) be amused by vague assertions of the prosperity of the Company's concerns. I should suppose no such persons will be found.

From this view of the subject, I would suggest to the Proprietors present, before any further proceedings, that an Inventory of the Company's Property should be taken, so that the real value of the Works may be ascertained.

I will now beg leave to contrast the state of the Company's concerns in the year 1815, and at the present day. In 1815, One Engine wrought 12 hours daily, and the Revenue that year was L3,147 : 8*s.* At the present day, the two Engines are at work 33 hours daily, and the Revenue for this year is L.4003 : 13*s.* : 9*d.* The quantity of water raised to the City, is nearly three times what it was in the year 1815, and the Revenue has only increased L.856 : 5*s.* : 9*d.* But when we compare the Stock, Annual Expenditure, and Revenue of the Glasgow Water Company, with that of the Cranstonhill Company, the question will naturally arise, what is the cause of the great disproportion of the Revenues of the Companies? A very slight consideration of this subject must convince any impartial inquirer that if the schemes formerly put in practice are not changed, and if Proprietors dream of success arising from the present plans adopted, they will be grievously disappointed, and one might be disposed to wonder (if any thing in this age of projects could excite wonder,) how so many persons could be found to embark in such an undertaking, without trying at least to form some definite notion of the manner in which it was to operate.

Should these remarks be found worthy the notice of any of the proprietors, I have still farther observations to make, equally important to the interest of the Company at large.—I am, Ladies and Gentlemen,

Your most obedient humble Servant,
WILLIAM WATT.

Macalpine-Street, Glasgow, 12th June, 1826.

"To a philosophic eye, there is nothing more worthy of admiration than the structure of animals, by which they are qualified to support life in the elements and climates to which they are appropriated; and of all natural bodies it may be generally confessed, that they exhibit evidences of divine wisdom, bear their testimony to the supreme reason, and excite, in the mind, new raptures of gratitude, and new incentives to piety."—*Johnson.*

GENTLEMEN,—When a little fellow, sufficiently improvident and impolitic, paddling each pond and pebbly brook, in garb succinct, with neighbour *Emy*, we recollect of having often observed long emaciated eels in wells and ponds in which horses were wont to be watered; this unsightly sight we, at the time, viewed with puerile apathy and solidity; but upon recent retrospect of our juvenile rambling and adventures, the reminiscence of these local eels really struck us with peculiar force. That horse hairs were animable seemed to us an idea uncouth, unphilosophical, and unnatural; we have indeed seen logs of wood which, being tenants of the mighty brine for a great length of time, were covered all over with bivalves of a fleshy substance, and in each bivalve a fowl full fledged and actually alive.[*] This perhaps may be called *transmutation*, which is no uncommon thing with great Alchymist NATURE; but a leady inanimate, retaining its pristine identity fairly vivified, has the expertest legerdemain ever seen?

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[*] Whether this fowl be what is called a *Barnacle* I do not know, of this I am sure, that I have had ocular demonstration, of the fact, of its existence. If it be the barnacle, it is not "like a goose" as Dr. Johnson says: it is black and Dutch built, with an orange coloured bill resembling in shape the comb, or crest of a cock, and with roots for wings. It has never been known to quit its native element for a moment, and having no wings to perform the process of incubation at sea, there is every reason to believe it never propagates!

In order to an experiment, however, we robbed a horse's tail of a few hairs, put them in a cistern full of water, and watched them with all a parent's care and fondness. Upon the eleventh day our submarine care began to exhibit signs of animation; by the fourteenth they acquired the art of locomotion, and by this time, which is the eighteenth day, they are, to the number of 2 dozen, all and whole, so nimble and agile, that they seem to want nothing but space and spoil!!

"It is impossible," says the wonderful author of our motto, "to determine the limits of inquiry, or to foresee what consequences a new discovery may produce: all that is great was at first little, and rose to its present bulk by gradual accessions, and accumulated labours;" whether *our* discovery be really *a discovery* we will not determine, we, at least, have never read any thing upon the subject, but this perhaps may be attributed to our nescience of authors. Of the eels, in question, if any of your more intelligent correspondents will give us the history, it shall certainly be very acceptable. Are they capable of rotundity? Does longevity own them? or, are they like most abortive monstrous brutes, ephemeric and evanescent. Impatiently waiting a reply, we are, Gentlemen,

Your's &c.

L. M'L.

Island of Coll, July, 1826.

GENTLEMEN,—You will please correct in your next, the following *typographical* errors which occurred in your last number, under the article on English Grammar:

For the 3d sing. pres. ind. act. read, "he loves."

For the 3d sing. pres. sub. act. read, "he love," without the *s*.

For the singular number of the past subj. passive, read, "I were loved, thou wert loved, he were loved."

And in the sentence, "while the first clause *ends* in point of the subjunctive mood, the second *ends* in regard to the indicative," read, *errs* instead of *ends*.

Besides these, there are some other inadvertencies of less importance, which do not require to be enumerated: but, you will perceive that the above, as they materially affect the subject, merit at least a simple statement. It is indeed an anomaly in the Grammar of our language which would afford no little matter for Philological discussion, and which I may perhaps take up at some future period, that while in the active voice of the verb, the past tenses of the indicative and subjunctive moods unite as one and the same; in the passive voice, the past tenses are, on the contrary, entirely different.—I remain,

Yours, very respectfully,

J. G.

Glasgow, 17th July, 1826.

GENTLEMEN,—As every anecdote connected with Professor Anderson, is read with interest by a great majority of your readers, I have sent you the following, though not strictly philosophical, yet, I think, the admirers of the Professor will hail it with delight. If you think it worth a place in your useful Magazine, by inserting it you will oblige,

Your's, &c.

R. G.

Glasgow, 13th July, 1826.

The author of the Ladies' Petition to Dr. Moyes was a Dr. Henry of Edinburgh; it was first printed in a Periodical entitled the Bee, in February 1791, signed "300 Ladies." It was written in the hour of Festivity, without the least thought of it ever being printed. And while the company, male and female, attacked him for his ungallant satire, some proposing to change this line, some that; Professor Anderson produced the following lines, which he wished put down in place of the last six lines in the original:—

If you these virgin prayers reject
By influence male—go and protect
Old bachelors, and peevish fools,
And coxcombs young who are their tools,
Who think, with disappointed pride,
To dare our charms, and us deride;
Tell them, you can disarm the cloud,
Though fully charged and thund'ring loud,
But let them know, the lightning of the eye
Has no conductor like a thund'ring sky.

ENTLEMEN,—I shall consider my-
greatly obliged, if you would give
n your inestimable publication, an
er to the following question, viz.:
t is the best receipt for taking ink
s out of mahogany and carpets?—
nain, Gentlemen,

Your obedient servant,

A FRIEND TO THE LADIES.

GENTLEMEN,—If any of your numerous readers would, through the medium of your very useful Magazine, favour me with a description of Stirling's Air Engine, and also a description and drawing of the Sliding Valve, as it is now used in Steam Engines, they would confer a great favour on

A YOUNG MECHANIC.

Glasgow, 10th July, 1826.

MISCELLANIES.

nders of the Valley of Mendoza.—
he valley of Mendoza, in South
rica, there is a combination of na-
curiosities, which has probably no
el in any other part of the world.
in the compass of a few roods are to
ind a sublime and perfect natural
e over a rapid river, and a collec-
f warm and mineral springs of the
various and opposite qualities, all
ed in a beautiful green valley,
led on both sides by lofty moun-
covered with eternal snows. The
Mr. Brigham, who visited this in-
ng spot in his journey across the
s, from Buenos Ayres to Chili,
lescribes it in a letter, which we
the Missionary Herald for May:
'his bridge, consisting of limestone
is suspended over the Mendoza
at a place where it is at least 100
ide, and running at the rate of
miles an hour. Its height above
ter in the centre is, as near as we
judge, about 70 feet; and sloping
he centre to the ends, so as to
t the usual curve of artificial
s. Its width is about 30 feet; its
ess at the top of the arch, 8;
s the ends, 16 or 18. Indeed,
the symmetry and regularity of
riosity, in all respects, that a
r, placed twenty roods above or
would have no hesitation in pro-
ng it the work of man. Its
its width, thickness in the cen-
d growing thickness towards the
its, would all tend to give him
npression. But on nearer ap-
he would see that it was formed
same hand which made the moun-
bove it, and the stream which
elow. The probability is, that
ce was once a cataract, the water
g over the top of what is now the bridge, but that the stream found at length a passage through the rock at the top of the present arch, and has been wearing down its bed until it exhibits the present curiosity.

But this bridge has not only the dimensions and appearance of an artificial bridge; it serves also its purposes. Tradition says, that, in former times, it was the great crossing place of the Indians in their journeys north and south, and this tradition is rendered credible by the fact, that the ruins of large stone fortifications, called los tambos, are now seen but a few leagues below; and also the fact, that the Mendoza can nowhere else be crossed nearer than 20 or 30 miles above, or 70 below. We saw at this time a large drove of mules on the opposite side of the bridge, and also rode over our own, and back again without their having any suspicion (apparently) of its being different from that built by the Mendozians.

But the bridge itself is only one of the curiosities here collected. Under the south end of the bridge, thirty feet down there projects from the abutment a flat table twenty feet square, through which boils up, with resistless force, two sulphur springs, which cannot in temperature be less than 120 degrees of Fahrenheit. Where one of these springs forces itself up, a basin has been formed in the rock sufficiently large and deep for bathing, as I had personal experience. I employed a Peon to hold fast a laso, which was fastened around my body, whle I descended to the table mentioned, and enjoyed the luxury of this matchless natural bath. Through the bridge, over this table, the water was trickling, and had formed on its lower side many thousands of stalactites, while numerous stalagtites of all forms were resting on the surface of the table. Many of them, by falling on places where there was water, were oval, others were perfectly globular, smooth as polished glass on the half which was down, and thickly set with small crystals on the half above. Breaking these globules they were found to contain a series of coats like the onion, and a kind of dark spungy substance within. I did not fail of course to bring away several specimens of these.

About six or eight rods west of the bridge, in the side of the south bank, and half way down to the river, there is formed a rock nearly in size, and exactly in shape like a common hay-stack, and from the very pinnacle of which gushes up another sulphureous spring and pours its waters down every side of the rock, tinging it with a yellow colour. I do not know that it is possible for this spring, by calcareous sulphureous deposites, to have formed this singular rock, but its perfect regularity and colour look as if it had done it, in some measure at least, and given it its peculiar shape. The basin in the top of the rock could be seen with perfect clearness, and contained, apparently, about four or six gallons of water, which, as has been said, was constantly passing off.

Eight or ten rods south of the bridge, in the acclivity of the hill, is another large sulphur spring, of the temperature of that in the table below, and where, by *art*, a fine bathing place has been formed which travellers seldom fail to enjoy.

But this is not all. Only seven paces west from this great warm sulphur fountain, gushes up another of a totally different character. Its temperature, so near as I could judge, (for I had broken my thermometer a short distance back,) was about that of common spring water; its taste near that of the Seltzer waters; and, by the sides of the little rivulet which it gave rise to, was deposited a white acrid incrustation. When passed to the north side of the bridge, I could distinctly see the white and the yellow parallel streaks, formed by the rill of these two unlike neighbouring springs.

The valley, through which the Mendoza passes at this place is nearly half a mile in width, with mountains of immense height on the north and south, covered with snow. The valley itself, however, is by day, of fine temperature, gently descending toward the river on both sides, with a smooth green turf to the very edge of its deep channel. The entrance of the bridge at both its ends is as smooth and regular as that of any artificial one, and has over it as good a road, in all respects, for horses and carriages.

The curiosities of this valley are indeed striking, and would well repay the lovers of nature who must go from Buenos Ayres to Chili, for all their labour in passing the Andes.

The Passage of the Andes.—Mr. Brigham, the American Missionary in South America, thus describes the laderas, or awful precipices, which he was obliged to pass in his journey over the Andes, from Mendoza to Santiago. We copy the account from his journal in the Missionary Herald for May.

"Leaving our place of encampment, we travelled for four hours, along the bank of the river on a gradually ascending, but yet wide and beautiful road. But now we reached the first of the *laderas*, of which I had heard much, dreaded some, and yet long wished to see. To conceive the nature of these laderas, it must be understood, that the road up this mountain is a long and narrow deep cut valley down which descends a large and rapid river. The road is on the north side of the stream, and generally the space between it and the parallel lofty mountains is ten or twelve rods wide, sufficiently so for a good road even for carriages. It occurs, however, in several instances, that a spur of this parallel mountain projects and extends to the very brink of the river, leaving you the alternative either to pass over its high snow-capt summit, or crawl along the precipice by the side of the river, at the ordinary elevation of the common road. The last course, by the ladera *precipice*, is sometimes the only one where the spur can possibly be passed. How this road along the laderas, rather this narrow mule path was first formed, it is not easy to see. The precipice, or slope of the mountain, toward the river, though not perpendicular, is nearly so, is as an angle of 75 if not 80 degrees with the horizon. The length of the laderas is from twelve to thirty rods, and the path along the sides from one to two feet in width, just sufficient for the mule to pass. The mountain on the right

o close, that, sitting on the
often touch it with your knee,
, and can sometimes with your
looking up, its top is in the
But on the left hand, the pre-
ow is the place of horror.
down a gulf of five, and in
, seven hundred feet descent,
tom of which rolls the furious
eight miles an hour, bearing
trees, leaves, grass, and mud,
bed stones and rocks, conti-
mbling like distant thunder.
s the descent, that little stones
m the path, are almost in-
the river, and by one stumble,
f the mule, you fall headlong,
but he who made the moun-
save you. If there is a place
gged earth, which deserves to
sublime, it is that seen by him
s the laderas in the Andes of
erica.

hile I pronounce the places
to be sublime, and even aw-
n who beholds them, I must
m the opinion of those, who
e is with proper caution any
nger in passing them. What
t there is not, is the fact, that
om I have seen, knows of any
e having been here lost, al-
is road has been travelled for
n two centuries and a half.
e often lost here; not a year
which several are not hurled
e gulfs, and their cargoes lost.
is owing to the fact, that they
y boxes, or sacks, of such mag-
to strike against the mountain
path, and force the poor ani-
ong off the other side into the
low. That this might not oc-
our mules and baggage, we
sos to be put around the necks
which had the large and valua-
es, and that they should be led
laderas. But this precaution
taken where a troop of several
pass, as is often done, conse-
ometimes by touching the up-
s and sometimes by the mules
each other, cargoes are lost.
a short time since one went
gulf with a load worth seven
dollars, in silver and gold.
vain to look for lost articles
the river sweeps every thing
course, and one can scarcely
waters with any safety, till it enters the Mendoza plains thirty miles below. In passing the first ladera, we were greatly alarmed for a short time, by a circumstance which grew out of carelessness, not sending one forward on foot, as we ought to have done, to see if the way was clear, six of us had advanced too far, that we could not return, when we saw entering the west end of the ladera a drove of mules which soon must meet us. What was to be done? For either party to return was impossible; to pass each other no less so. I would almost have given a limb to have been free from the danger which threatened. As a good providence ordained it, however, our guide recollected that, in the centre of the ladera, then out of sight, there was a small ravine, or break in the mountain, where a brook descended, and where if we could reach before the other loose mules met us, we could probably halt in safety. We reached the wished for spot, and crowded our six mules in a small excavation, which a cascade, when the brook was high, had made, and waited till 390 mules, and four men, had passed. We then came out of our den, passed the other part of the ladera, and reached in safety another wide and good road.

Just before night we passed the second ladera called *ladera de las vacas*, the worst of them all, but which with caution we passed in perfect safety. Over this I ventured myself to walk, and let the mule follow but would never do it again. One's head is liable to swim, and then his feet to stumble, whereas a mule's head, in such places, is always clear, and his feet secure.

The sagacity of this animal in travelling over these rough and dangerous roads is truly remarkable. When he steps on a stone which rolls, or finds his foot like to give way, instead of springing to recover himself, like the horse, he lifts his feet, and places them again with increased slowness and caution until the danger is passed. When carrying baggage, he soon learns to keep at such a distance from loaded mules, and other objects which he may meet, as that his cargo seldom strikes any thing around him. In crossing these narrow laderas I observed that the older baggage mules, to avoid a contact with the mountains above, would walk almost to the extreme lower edge of the path. This caution of course arises not from any design to preserve the load in charge, but to save themselves from the severe jar which every such contact gives them.

In the worst and most dangerous places they are perfectly composed, and if let alone, and suffered to pitch their own way, will carry you through them all in safety, but as the Peones say, "it is dangerous to force one of these animals, where he, on mature deliberation, thinks it not best to go."

Samnite Coins.—A wood-cutter has lately felled, in the forest of Ardennis, a very old and lofty oak, which concealed in its trunk some fragments of vases for sacrifice, and medals. It has been ascertained that these pieces were coined by the Samnites, so far back as 276 years before the foundation of Rome. Therefore the age of this tree, which at that period might have been sixty or eighty years old, amounts to near 3600! It is the "Echo du Nord" that relates this fact. We must believe it, unless we choose to make a journey to Ardennes.

The Chapel Tree.—There is at present at Allonvile (pays de Caux) an oak, the circumference of which is thirty-four feet above the roots, and at the height of a man, twenty-six feet. Its elevation does not accord with its thickness. It is chiefly at the top that it extends its width. Its enormous branches rising from the trunk at seven or eight feet from its base, spread out horizontally in such a manner as to cover an immense space. The trunk from the roots to the summit, is of a very decided conic form, and the interior of this cone is hollowed throughout the whole length. Different openings, of which the greatest is below, give access to this cavity. All the central parts have been long since destroyed: it is only by the exterior layers of wood, and by its bark, that this ancient child of the forest at present subsists, full of vigour, clothed with a thick foliage, and loaded with acorns. The lower part of the cavity has been converted into a chapel, six or seven feet in diameter, carefully floored with marble. The image of the virg ates the altar, and a grated doo this humble sanctuary, without ing the image from the sight or of the pious traveller. Above th and which is also enclosed, is a lit ber containing a bed (a habitatio of some new stylite,) and to whic conducted by a staircase that win the trunk. Its summit, which since attained its full height, a presents at the point of its ter the diameter of a very thick tr with laths, and covered with a roof, forms a belfrey, surmoun an iron cross, which rises in resque manner from amidst the like that of an antique hermitag the woods that surround it. C entrance of the chapel we re inscription:—*Erigee par l'A Detroit, Cure l'Allouville, en* 1696. At certain periods of t the Chapel of the Oak is used ceremonies of worship. We suppose the tree of Allouville to than from eight to nine hundre old. Perhaps in its youth, it shades to the companions of W assembling for the conquest of E perhaps the Norman Troubad turning from the first crusade sung more than once the expl Godfrey and Raymond to his as ed compatriots.

Medals.—The trenches that ha lately opened at Bagueres to foundations of the beautiful es ment that is to bear the name *Thermes de Maria Therese,* have the discovery, at the depth of and a half, of several square p also medals of the reigns of An Trajan, Marcus Aurelius, &c These medals have the form of The elegance of the mouldings a nature of the cement leave no dou these discovered remains have b work of the Romans. The ancie of the town were built in part upo pools, about the year 1200, an yet exists of them increases the di of making the trenches.

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A Committee of Civil Engineers and Practical Mechanics.

> " Knowledge dwells
> In heads replete with thoughts of other men."—*Cowper.*

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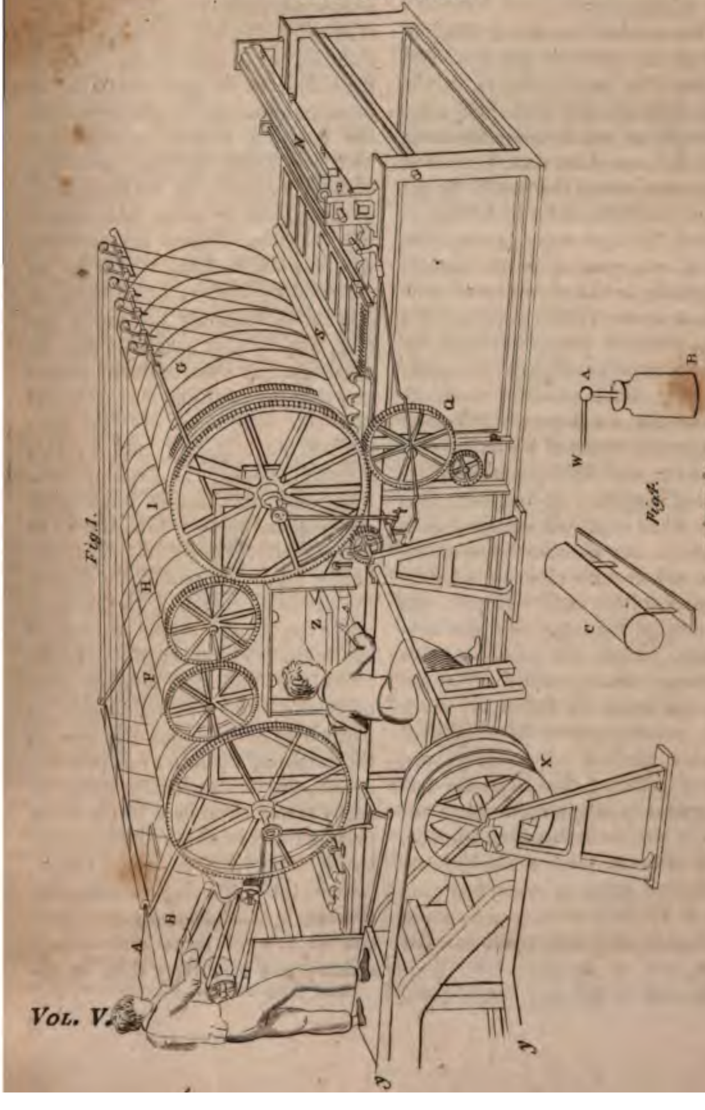
PRINTING PRESSES INVENTED BY MESSRS. APPLEGATH AND COWPER.



PRINTING PRESSES.

No improvement of importance was made on Printing Presses until 1790, when Mr. William Nicholson, the editor of the Philosophical Magazine, obtained a patent for a machine, for printing on *paper*, *linen*, *cotton*, *woollen*, and other articles, in a more neat, cheap, and accurate method, than by the printing presses then in use.

This method consisted, first, in making his moulds, punches, and matrices, for casting letters, in the same manner, and with the same materials, as other letter-founders, with the exception that, instead of leaving a space in the mould for the stem of one letter only, he left spaces for two, three, or more letters, to be cast at one pouring of the metal; and at the lower extremity of each of these spaces (which communicate by a common groove or top) he placed a matrix, or piece of copper, with the letter punched upon its face in the usual way. He then brought the stems of his letters to a due form and finish, not only by rubbing it upon a stone, and scraping it when arranged in the finishing-stick, but likewise by scraping it, on one or more sides, in a finishing-stick whose hollowed part was less deep at the inner than the outer side. That side of the groove which was nearest the face of the disposed letter, he called the outer side; and the purpose accomplished by this method of scraping was, that of rendering the tail of the letter gradually smaller the more remote it was, or farther from the face. Such letters as these could be firmly imposed upon a cylindrical surface, in the same manner as common letters are imposed upon a flat stone.

Secondly, he applied the ink, or colouring matter to the types, forms, or plates, by causing the surface of a cylinder smeared or wetted with the colouring matter, to roll over the surfaces of the said forms or plates; or by causing the forms or plates to apply themselves successively to the surface of the cylinder. The surface of this colouring cylinder was covered with leather, or with linen, woollen, or cotton cloth. When the colour to be used was thin, as in calico-printing, he proposed that the covering should be supported by a firm elastic stuffing, consisting of hair, or wool, or woollen-cloth, wrapped one or more folds round the cylinder. When the covering was of woollen cloth, it was to be defended by leather, or oil-skin, to prevent its imbibing too much colour, and by that means losing its elasticity. It was absolutely necessary that the colouring matter should be evenly distributed over the surface of the cylinder; and for this purpose, when the colour was thick and stiff, as in letter-press printing, he applied two, three, or more small cylinders, called distributing rollers, longitudinally against the colouring cylinders, so that they might be turned by the motion of the latter. The effect of this application was, that every lump or mass of colour which was redundant, or irregularly placed upon the face of the colouring cylinder, was pressed, spread, and partly taken up and carried by the small rollers to the other parts of the colouring cylinder; thereby preserving an even face of colour. When the colouring matter was thinner, he did not apply more than one or two of these distributing-rollers; and when very thin, he applied an even blunt-edge of metal, or wood, or a straight brush, or both of these last against the colouring cylinder, for the purpose of rendering its colour uniform. When he applied colour to an engraved plate, or cylinder, or through the interstices of a perforated pattern, as in the manufacturing of some kinds of paper-hangings, he used a cylinder entirely covered with hair or bristles in the manner of a brush.

And thirdly, he performed all his impressions, even in letter-press printing, by the action of a cylinder or cylindrical surface.

Though Mr. Nicholson did not carry his ideas into successful practice, he may deservedly be considered the father of modern improvements in this important art. With him originated the idea of inking types by means of rollers, and of producing impressions by means of cylinders, which constitute the essential parts of all modern printing machines.

The honour of being the first to carry these ideas into successful practice is due to Mr. Koenig, by birth a Saxon, who after various attempts to improve the common press, and which resulted, to use his own words, "in discovering that they were only employing a horse to do what had been before done by a man," succeeded in producing a machine in which the impression is given by a cylinder. This machine was erected at the office of the Times newspaper, and two on a similar principle were erected at Mr. Bensley's printing office, and although some publications have stated that the latter were destroyed by fire, in 1819, they continue to be worked at the present day. These errors may have arisen from the great difference in the appearance of the machine now, and when first erected. This is owing to a reduction of the complexity of the inking apparatus, by Messrs. Applegath and Cowper, who have produced a machine far superior to that by Mr. Koenig, and which possesses nothing in common with it, but the pressing cylinders, the inking-rollers, and the tapes to hold the sheet of paper on the cylinders. The pressing-cylinders and inking-rollers were first suggested by Mr. Nicholson; and tapes are similarly used in machines for the ruling of paper for account-books. These gentlemen, therefore, though producing their machine subsequently to Mr. Koenig, cannot, with justice, be accused of having in the slightest degree infringed upon his invention. Mr. Koenig's machine possessed originally *sixty* wheels; Messrs. Applegath's and Cowper's but *sixteen;* and the machines of the former are now almost entirely superseded, even in the office of Mr. Bensley, the principal proprietor of Koenig's patent, by the improved machines of Applegath and Cowper.

A perspective view of Messrs. Applegath and Cowper's machine is represented by fig. 1, and a longitudinal section, to explain the manner in which the paper passes through to receive the impression upon both sides, and the mode of applying the ink to the surface of the types by fig. 2. Though in these figures, all the material motions of the machine are displayed, yet some of the minute parts, which produce the various movements, have been omitted, in consequence of the diminutive scale of the figures, which is only about one-third of an inch to a foot.

The supply of the blank paper is laid upon a support, or table, A, from whence the sheets are taken, one by one, by a boy, standing upon an elevated platform, who lays them out upon the table, B, which has a number of narrow linen tapes of girths passing across its surface. These tapes are formed into endless bands, which extend round the cylinders, or rollers, C and D, in such a manner, that when the rollers are turned round, the motion of the tapes will carry the sheet of paper along with them, and deliver it over the roller E, where it is seized between two systems of endless tapes, passing over a series of rollers to keep them extended. These endless tapes are so adapted, in number and position, as to fall between the pages of printing, and also on the outsides, or beyond the margin of the printing; they may, therefore, remain in contact with the sheet of paper on both sides during its whole passage through the machine; by which means, the paper being once received or taken in between the two systems of endless tapes, it will be capable of continuing its motion along with the tapes, in order to bring it into a situation to be printed on both sides, without destroying the register (or coincidence of the pages on the opposite sides of the sheet.) F and G represent the two main cylinders which effect the pressure upon the paper. They are mounted upon strong axes, which turn in stationary bearings affixed to the main force of the machine. H and I are two intermediate cylinders, situated upon axes between the main cylinders. Their use is to effect the inversion of the sheet of paper, in order to print the opposite side.

We must now describe the manner in which the two systems of endless tapes before mentioned are arranged, to give a clear idea of the operation of the machine. We will suppose one system of tapes to commence at the upper part of the roller E, from whence they proceed in contact with the under portion of the circumference of the main cylinder F; they then pass over the upper part of the intermediate cylinder H, and under the intermediate cylinder I, from whence they proceed to encompass a considerable portion of the main cylinder G; and by passing in contact with the rollers *a*, *b*, *c*, *d*, and *e*, they arrive again at the roller E, from whence they commenced, thereby forming one of the systems of endless tapes. The other system we will suppose to commence at the roller *h*. They are equal in their number to the tapes already described, and correspond also with them in their place upon the cylinders, so that the sheets of paper may be securely held between them. The second tapes descend from the roller *h* to the roller E, where they meet and coincide with the first system, in such a manner that the tapes proceed together under the main cylinder F, over the cylinder H, under the cylinder I, and round the main cylinder G, until they arrive at the roller *i*, where they separate; having remained thus far in actual contact, except at the places where the sheets of paper are held between them. From the roller *i*, the paper descends to the roller *k*, and by passing in contact with the rollers *m*, *n*, and *o*, they arrive at the roller *h*, from whence they commenced. Thus the two systems of the endless tapes are established and arranged so as to be capable of circulating continually, without interfering with each other.

(To be Concluded in our next, when figs. 3 and 4, above referred to, will be given.)

ELECTRICAL EXPERIMENT.

THE following is an interesting experiment in Electricity, and illustrative of some of its general principles.

A B, Fig. 4, is a Leyden jar, with a wire W A of small diameter, connected with the nob A of the jar. If the phial be placed so that the extremity W of the wire be at the distance of 4 or even 6 inches from a conductor C, kept charged with electricity, the jar will be charged in the course of a few minutes. The jar might perhaps receive a sensible charge in a short time at a still greater distance when the atmosphere is very dry and favourable to the action of the machine. I am not certain, if this experiment has ever been proposed before.

A. B.

REVIEW.

THE BOOK OF NATURE LAID OPEN.

BY GEORGE MILLER, DUNBAR.*

THIS is a useful, meritorious, and unpretending little work on Natural Philosophy, by the author of that much valued Poor Man's Friend "The Cheap Magazine." We have perused it with much satisfaction, and do not hesitate to state our conviction, that it will be found one of the most beneficial works of the kind which has yet come before the public. It cannot fail, if once it is sufficiently well known, to recommend itself to the attention of all classes of society. The author's object will be best learned from the following extracts from the preface to his work.

THIS work is respectfully recommended to the attention of those parents, guardians, and heads of families, who feel anxious to have the minds of those committed to their charge, early imbued with sentiments of rational piety and the most pure devotion, arising from the consideration of objects that every where surround them in the great temple of the universe, and to some of which they may every moment have access:—objects, that have attracted the attention of, and given lessons of wisdom to, the wisest and best of men in all ages; and to which, the Saviour of the world, did not think it derogatory to his mission, to refer his immediate followers in the words that I have selected for one of my mottos, and through them, his disciples in all time coming, to learn a lesson of the greatest importance, amidst the cares, the anxieties, and vicissitudes of life.

Dr Dwight, in his excellent System of Theology, expresses himself on this subject, in the following strong and energetic language; "I am apprehensive, that even good men are prone to pay less attention to the works of creation and providence than piety demands, and the Scriptures require.—He who does not find in the various beautiful, sublime, awful, and astonishing objects presented to us in creation and providence, irresistible and glorious reasons for admiring, adoring, loving, and praising his Creator, *has not a claim to evangelical piety*. David did not act in this manner. All who, like David, feel the spirit of the gospel, will like him also rejoice in those works in which God rejoices; will delight to contemplate them with wonder, reverence, and gratitude; will find God every where in the works of his hands; and passing beyond those second causes, which are merely instruments of his agency, will see every where displayed the finger and character of the Divine workman."—And, in the words of another eminent divine, no less celebrated among ourselves (Dr. Chalmers,) "It is truly a most Christian exercise, to extract a sentiment of piety from the works and appearances of nature. It has the authority of the sacred writers upon its side, and even our Saviour himself gives it the weight and the solemnity of his example. He expatiates on the beauties of a single flower, and draws from it the delightful argument of confidence in God. He gives us to see that taste may be combined with, and that the same heart may be occupied with all that is serious in the contemplations of religion, and be at the same time alive to the charms and the loveliness of nature."

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* Popular Philosophy; or, the Book of Nature Laid Open upon Christian Principles, and agreeably to the Lights of Modern Science, and the Progress of new Discovery. A new, improved, and much enlarged edition, of "*The Book of Nature Laid Open*, in a cursory and popular survey of several striking facts in Natural History, and in the Phenomena and Constitution of the Universe; in which the Wisdom of God, and his goodness in their subserviency to man, are distinctly traced and pointed out."—*The whole occasionally* intermixed with suitable moral reflections, calculated to excite devo*tional feelings in the breasts* of the young and to raise the thoughts of the adult—From Nature up *to Nature's God.*

It is submitted to the consideration of those conductors of Seminaries of Education and instructors of Youth, who are solicitous for the moral as well as the intellectual improvement of their pupils; and being sensible, that there has long existed a chasm in that particular department of our Scholastic literature, which should have for its object *the making the more advanced classes in particular*, better acquainted with some of the most striking facts in natural history, and in the phenomena and constitution of the universe, would willingly embrace any favourable opportunity of recommending to their notice, or putting into their hands, a work *calculated to supply* the place of such a *desideratum*—in the form of a POPULAR and AMUSING, from the manner in which it is written, yet COMPREHENSIVE and INSTRUCTIVE (although compendious) TREATISE;—by which, without detriment to their other studies, the juvenile minds of both sexes might be, as it were, *allured* to "Remember their CREATOR" in the days of their youth; and to hold converse with their MAKER through the medium of his works, in that season when the mind is most susceptible of tender impressions, and the young idea can be most easily trained in the way that it should go, and taught to shoot up in that most noble of all directions—from the things that are seen, and the wonders of Creation, to the incomprehensible nature of His Essence, who is the Lord and Maker of all—FROM NATURE UP TO NATURE'S GOD!—That so they might be enabled to go forth to fulfil their several duties and avocations in life, not only fraught with some of the other necessary, and it may be, ornamental branches of education, but with their minds fortified by *that sovereign antidote against despair*, that bore up our enterprising countryman, Mungo Park, in the wilderness, and enabled him to extract the balm of consolation, from the beautiful appearance, in fructuation, of A SMALL MOSS; viz. *an aptitude to recognize* A PRESENT DEITY, *even in the minutest, and, seemingly most forlorn, of his works.*

But there is another, and a most numerous class, for whose use this improved edition of *The Book of Nature Laid Open* is peculiarly adapted. To the numerous MECHANICS' and ARTIZANS—TRADESMEN and AGRICULTURISTS—BUSY WORKMEN and OPERATIVE LABOURERS, in the great hive and vineyard of laudable human industry—whatever part they have been called to perform, or by whatever degree, shade or designation they choose to be distinguished;—particularly such as are scattered throughout our country towns, villages, and hamlets,—who not having had the advantage of a Popular Treatise of this kind put into their hands at an early period of their lives,—nor since enjoyed the benefit of a liberal education,—and being still prevented by their isolated situations in the country, from availing themselves of the lectures of those numerous Mechanics' Institutions that are springing up around them in the larger towns,—have nevertheless, a strong desire to be taught to range in the flowery paths of science,—to have their minds stored with, and their practice guided by, those numerous useful and incontrovertible facts that are so abundantly diffused through, and many of which have been recently brought to light in the comprehensive pages of the Book of Nature;—and to experience some of those delightful sensations, with which the poet appears to have been overpowered, when he was forced to exclaim:

> "These are thy glorious works, Parent of Good!
> Almighty—thine this universal frame,
> Thus wondrous fair!—Thyself, how wondrous then!
> Unspeakable!"——

To such as these, I say, the present work is particularly recommended, as affording a source of the most rational recreation, and supplying the place of a course of philosophical lectures on the most popular and interesting subjects, at their own firesides; as well as to the special patronage of those of the same class, whose local situations in the larger towns give them more frequent opportunities of instruction—who have enrolled themselves in the number of students at these modern institutions, whose increase, if properly conducted and made subservient to the more ample diffusion of useful knowledge—with the corresponding exertions of the pulpit and the press—backed by the unprecedented, yet growing demand, among our working population, for publications of the first importance and such undoubted utility,—together with other simultaneous movements so observable in our times;—may be considered as harbingers, if not the actual commencement, of that new era in the progress of civilization and refinement, when "*the earth shall be full of the knowledge of the Lord, as the waters cover the sea.*"—To those, it is expected, this humble performance will in due time recommend itself, not only as containing something highly congenial to their turn of thinking, and a useful text book; but, as a friendly monitor, that may occasionally bring some important truth or remarkable fact, (calculated to excite present inquiry, or stimulate to new research,) to their remembrance.

It would no doubt be presumptuous to say, that those who move in the higher spheres, and so are enabled by their influence and superior command of capital to extend their researches and carry their plans into execution upon the most extensive scales, are likely to be much benefited by the perusal of a work of such humble pretensions,—and why should they? They have already, it is to be supposed, had the advantage of what this, to a certain extent, is meant to supply to the juvenile branches of a very considerable portion of the community, as well as the adult among the more laborious classes—a liberal education;—and they have also the means of providing themselves with the best authors upon any particular subject with which they wish to become acquainted; but, is it not *at least possible*, that even some of these may be brought to profit by a casual glance at a hint thrown out, or a reference given to some respectable authority, in this NEW COMPENDIUM OF POPULAR PHILOSOPHY?

The time has now gone by, when the wealth of the landed proprietor was supposed to be chiefly confined to the woods and waters, and other outward appendages of the surface of his domain.—The researches of the geologist, and the valuable discoveries in modern mineralogy, have taught him to cast his thoughts downwards: and if, in course of our progress among these subterranean regions, directed by the lights of modern science, some new and important fact shall have been brought to light, in regard to which, we shall have no other merit than merely making the circumstance more generally known,—yet, the mere circumstance of giving the discovery more publicity, may be the means of bringing it under the consideration of some who would otherwise never have heard of it, and so far our little work may be found useful in a way, that, at first, we neither could have anticipated or expected—while the hints thrown out in regard to the process adopted by Nature in the decomposition of the old, and formation of new materials—the approved methods of meliorating the soils—the most suitable materials to be used in the construction of buildings—and other useful matters and occasional references,—that will be found interspersed throughout the work, must give it a value and an interest, in the estimation of even the most calculating, that it could never otherwise have aspired to.

How far the author may be supposed capacitated or fitted for the task, he has thus voluntarily imposed upon himself, it does not become him to say:—and he will frankly confess, that, although his early predilection for such studies may fairly be inferred from the circumstance of his having turned his thoughts to the composition of the Book of Nature Laid Open in its original form, when he had scarcely completed his *twentieth year*; and it cannot be disputed, that he has had many opportunities since, of marking and tracing the progress of science, in the course of his literary pursuits, and long practice as a bookseller:—yet, it is not at all likely he would have come before the public on the present occasion, had he not been encouraged in the attempt, and sanctioned in the undertaking, by the opinion of one far more competent to decide, than he could be supposed to be, even putting prejudice out of the question.

In regard to the numerous alterations and emendations—the additions and improvements in the other parts of the work—they will speak for themselves; and it is humbly presumed, that as a few years have been allowed to elapse since the author was favoured with the above sentiments of the professor, it shall be made to appear, that these few years have not been suffered to pass in vain.

But this is not all. While these things were going forward in Scotland, and matters were in a train of progress to bring out "the Book of Nature Laid Open," in the enlarged and improved form in which it is now about to appear, the work, even in the humble and unassuming form in which it formerly made its appearance, seems to have attracted, *in no ordinary degree*, the attention of some ready Bibliographer in the south; for the public will now read with surprise, that "the Book of Nature Laid Open," lately ushered into the world from the London press, as the production of a *Reverend William Hutton, A. M.* is, for the greater part, an almost *verbatim* transcript of *a portion* of the present work, as it first made its appearance in the periodical publication above alluded to!

Whether this *gentleman*, or *he* who personifies him, shall have reason, ultimately, to congratulate himself on such a procedure, time will shew,—but in the mean while, as he has been the means of making the work pass *rather prematurely* through the ordeal of criticism, it is hoped, that he will not refuse the LEGITIMATE AUTHOR *his share* of the *verdict* on the present occasion, seeing the decision.

(In our next, we will give some interesting extracts from this work of Mr. Millar's.)

STOCKTON, YARM, AND NORTON MECHANICS' INSTITUTION.

THE first Committee of this Institution have now closed their duties for the year, and have published a spirited report of their proceedings, and of the events connected with the Institution. In it they do not expatiate, as is a common practice in Reports of this nature, on the utility and advantages resulting to Society from the establishment of Institutions, for the instruction of persons in scientific pursuits. This proposition, from their own observation, appears to them incontrovertible: and they are satisfied, that to lay before man the means of cultivating and improving his mind, instead of withdrawing him, as some have asserted, from that circle in which Providence destined him to move, he is made a better man, a better servant, and a much more valuable member of Society. What has been the means of raising our native country to that eminence in civilization and improvement, which commands universal respect, and renders her the admiration of the world? Her improvement in the Arts and Sciences. From whom have those Arts and Sciences chiefly sprung? From men, who have emerged from the humbler walks of Life. "Newcomen was a Plumber. Smeaton and Watt were Watchmakers. Arkwright and Compton were Barbers. Wedgewood was a Potter. Brindley was a Millwright. Simpson was a Weaver. Hutton was a Pit boy. Whitehurst was a Watchmaker. Davy, who now fills the chair of the immortal Newton, was an apprentice to Dr. Beddoes."

Spirited support—liberal donations—and clever lecturers, have gained for this institution, but yet in its infancy, an elevated standing among the numerous establishments of a similar kind. A well selected Library has been formed—a useful set of apparatus has been procured—several Gentlemen of eminence have been engaged, to deliver courses of Lectures in the various branches of the Sciences and the Arts; and what is, above all, the most pleasant part of the information we have derived from this report, is, the universal—the undivided—the unimpared attention which the students give to what is going forward. In this neighbourhood there are but few Manufactories and it is estimated that there are but about 5000 Inhabitants; it, therefore, could not be looked for that a very numerous class would be formed; still, however, few though they be, its patrons are not discouraged in the fulfilment of their duty—the interest taken in it by those who are to derive the benefit from it, is their reward.

Such has been the commencement, such the success, and such is the present state of this Establishment. It can boast of being supported by many of the most ingenious and distinguished gentlemen in its neighbourhood, through whose munificence, added to its common resources, one of the best Philosophical Libraries has been collected.

WATCHES.

The theoretic philosopher, who ranges through the variegated fields of science, may gather the sweets as he passes along, and gratify his taste with fruits that he has had no share in rearing, at a very inconsiderable expense; but the pleasures which the practical man of science derives from the results of his successful experiments is much more exquisite: the previous impression made by contemplating the harmony that appears in the laws of nature; the satisfaction of proving the agreement or discrepancy between theory and practice; the prospect of benefiting society in some shape, and, perhaps, also the gratification of a certain degree of vanity, all concur in stimulating his exertions. If he should labour under any inconvenience in procuring the best means of prosecuting his labours, he will naturally avail himself of the best substitutes that the circumstances of his situation will allow. From this consideration, it becomes a matter of surprize that a more general attention is not paid to the philosophical uses that may be made of a common pocket watch. There are many observations and experiments in different departments of science, the accuracy of which depend greatly, and some of them entirely, on the accurate measurement of minute portions of time; such, for instance, as the determination of the velocity of sound, the nature of the descent of falling bodies, the measure of the sun's diameter, the distance of two contiguous, or at least apparently contiguous, heavenly bodies taken at their passage over the meridian, and the distance of places from the difference of the velocity of light and sound. A pendulum to swing seconds has usually been applied for these and similar purposes, and in an observatory is found to be very convenient; but a watch, by being more portable, is calculated to be more general in its application, and will measure *smaller* portions of time than any other instrument that has been invented; besides, it possesses this peculiar advantage, that in all situations the beats thereof may be counted by the ear, at the same time that the object of observation is viewed by the eye, so that no loss is incurred, as must inevitably happen, when the eye is used to view both the object and pendulum or second-index in succession, though it be ever so quick.

But it will be objected here, no doubt, that few watches measure time accurately, and also that, from the different constructions of watches, the times corresponding to their beats vary in a very considerable degree.

I allow these objections to be true, and conceive that the reason may be attributed to them, why the beat of a watch is not generally applied as the measure of the lowest denomination of sub-divisions of time: we shall endeavour to obviate these objections, and shew how any tolerably good watch, whatever be its construction, may be applied with advantage to many philosophical purposes.

We must, in the first place, consider that the portions of time which I propose to have measured by a watch are *small* portions only, and those to be counted not by a second hand, as is the custom with medical men, but altogether by the beats; in which case, if the watch be not liable to lose or gain time considerably in a day, the error in the rate of going will be extremely minute in the time corresponding to any number of beats that the memory can retain, or that the purposes to which I propose the application to be made, will require: and even if the error in the rate of going be considerable, so as to amount to many minutes in a day, as it is uniform, it may easily be allowed for by a correction; even if the error were five minutes per day, the allowance would be only one two hundred and eighty-eighth part ($\frac{1}{288}$) of the time observed. Hence the first objection, which relates to the error occasioned by the rate of going of any watch, will constitute no real obstacle to its application in the ascertaining of small portions of time, provided a sudden change of temperature be avoided at the time of using it; for it will be necessary that the rate of going be estimated when the temperature is the same, or very nearly the same, as when the watch is used for philosophical purposes; so that if it is usually worn in the pocket, it may be held in the hand to the ear, but if it be hanging in a room or in the open air where the rate of going is ascertained, it must be hung near the ear, under similar circumstances, where any observation is to be made by it.

As to the other objection, which applies to the variation in the length of the beats of two different watches, owing to the difference of their constructions, that they indicate hours and minutes alike, it may be removed very readily. All common watches have the same number of wheels and pinions, which are known by the same names, and placed, no matter how variously, so as to act together without interruption; but all watches have not their corresponding wheels and pinions divided into the same number of teeth and spaces, and to this circumstance it is entirely owing that the beats of different watches differ from each other. As the rate of going of a watch is regulated by the lengthening or shortening of a spring without any regard being paid to the numbers which compose the teeth of the wheels and pinions, a great latitude is allowable in the calculation of those numbers; of which the different makers avail themselves according as the numbers on the engines they use for cutting the teeth require: but whatever the number may be of which the wheel work consists, if we divide double the product of all the wheels, from the centre to the crown wheel inclusively, by the product of all the pinions with which they act, the quotient will be invariably the number of beats of the watch in question, in one hour; and again, if we divide this quotient by 3600, the number of seconds in an hour, this latter quotient will be the number of beats in every second, which may be carried to any number of places in decimals, and be copied upon the watch paper for inspection whenever it may be wanted.

When any particular watch is cleaned, the workman may be directed to count, and return in writing the numbers of the centre wheel, the third wheel, the contrate wheel, and the crown (balance) wheel, and also of the three pinions which they actuate, respectively, from which the calculation of the length of a beat is easily made by the rule just given, and when once made, will apply in all instances where that individual watch is used. It will be remarked here, that no notice is taken of the wheels and pinions which constitute the *dial work*, nor yet of the *great wheel* and pinion with which it acts: the use of the former of these is only to make the hour and minute hands revolve in their respective times, and may or may not be the same in all watches; and the use of the latter, the great wheel and its pinion, is to determine, in conjunction with the number of spirals on the fusee, the number of hours that the watch shall continue to go, at one winding up of the chain round the barrel of the main spring: all these wheels and pinions, therefore, it will be perceived, are unnecessary to be taken into the account in calculating the beats per hour. The reason, why *double* the product of the wheels specified is taken in the calculation, is this, that one tooth of the crown wheel completely escapes the palats at every two beats or vibrations of the balance. A few examples will render the general rule perfectly intelligible. Let us take for the first example, the number of a common watch given by Mr. Emerson in his "Tracts," which, according to this method of arrangement, stand thus,

48 Great wheel.
12—54 Centre wheel.
6—48 Third wheel.
6—48 Contrate wheel.
6—15 Crown whl.
2 Palats.

Now, omitting the great wheel and its pinion of 12, we have, $54 \times 48 \times 48 \times 15 \times 2 = 3732480$ for double the product of the specified wheels, and $6 \times 6 \times 6 = 216$ for the product of the specified pinion, and also $\frac{3732480}{216} = 17280$ are the number of beats in an hour, and $\frac{17280}{3600} = 48$, the exact number of beats per second; accordingly, Mr. Emerson says, that this watch makes "about $4\frac{3}{4}$ beats in a second." The number of spirals on the fusee is 7, there $7 \times \frac{48}{12} = 28$ is the number of hours that the watch will go at one winding up: likewise the dial work $\frac{40}{10} \times \frac{36}{12} = \frac{1440}{120} = 12$ shews that whilst the first driving pinion of 10 goes twelve times round the last wheel of 36 goes only once; whence the angular velocity of two hands carried by their hollow axles are to each other as 12 to 1. For a second example, I will take a watch which is in my own possession, the numbers of which in the calculation of beats per second will be thus: $60 \times 60 \times 60 \times 13 \times 2 = 5616000$, double the product of the wheels; and $8 \times 8 \times 6 = 384$ the product of the pinions; then $\frac{5616000}{384} = 14625$ will be the beats in an hour, and $\frac{14625}{3600} = 4{,}0625$, the beats per second.

Besides this I have examined two other common watches, one of which requires this calculation : $54 \times 52 \times 52 + 13 \times 2 = 3796416$ for double the product of the wheels, and $6 \times 6 \times 6 = 216$ for the product of the pinions, therefore, $\frac{3796416}{216} = 17576$ are the beats in an hour, and $\frac{17576}{3600} =$ 4,882 the beats per second by this watch; also double the product of the wheels of the other, viz. $56 \times 51 \times 50 \times 13 \times 2$ is 3712800, and the product of the pinions as in the last, $6 \times 6 \times 6 = 216$; consequently, $\frac{3712800}{216}$ gives 17188 beats in an hour, which divided by 3600 gives 4,7746 for the beats per second.

It remains now for an instance or two to be adduced for the application of the beats of a watch to philosophical purposes, in order to shew the practical utility of the method here proposed of measuring very small portions of time.

Let us suppose, for instance, with Dr. Herschel, that the annual parallax of the fixed stars may be ascertained by observing how the angle between two stars, very near to each other, varies in opposite parts of the year. For the purposes of determining an angle of this kind, where an accurate micrometer is wanting, let a telescope that has cross wires be directed to the stars, when passing the meridian, in such a manner, that the upright wire may be perpendicular to the horizon, and let it remain unmoved as soon as the former of the two stars is coming into the field of view; then fixing the eye to the telescope, and the watch to the ear, repeat the word *one* along with every beat of the watch, before the star is arrived at the perpendicular hair, until it is in conjunction with it, from which beat go on *two*, *three*, *four*, &c. putting down a finger of either hand at every twenty, till the second star is seen in the same situation that the leading one occupied at the commencement of the counting, then these beats divided by the beats per second marked on the watch-paper, will give the exact number of incorrect seconds, by which the following star passes later over the meridian than the leading one: when these seconds, and parts of second are ascertained, we have the following analogy for determining the angle, which includes also the correction. Namely, as the time of a sideral rotation of the earth, (which may be taken at 23 h. 56′ 4″,098, but more or less accordingly as the earth is near its aphelion or perihelion of its orbit), the daily error in the rate of going, is to 360, so is the observed number of seconds of time to the quantity of the required horizontal angle. The watch is here supposed to be regulated to shew solar time; but if it should be regulated exactly for sideral time, instead of 23 h. 56′ 4″,098 we must use exactly 24 hours in the analogy.

As a second instance, let it be required to ascertain the distance of the nearer of two electrified clouds from an observer, when there are successive peals of thunder to be heard: a little time before the expected repetition of a flash of lightning, place the watch at the ear, and commence the numbering of the beats at the instant that the flash is seen, as before directed, and take care to cease with the beginning of the report; then the beats converted into seconds, with the proportional part of the daily error added or subtracted, will give the difference of time taken up by the motion of the light and the sound: if lastly, we suppose light to be instantaneous at small distances, the distance of the nearer cloud will be had by multiplying the distance that sound is known to pass through in a second by the number of observed seconds obtained from the beats that were counted.

Many more instances might be here pointed out, in which the beats of a good watch would be extremely serviceable in the practical branches of Philosophy; but the occurrence of such instances will always point out the propriety of the application, when it is once known and practised.

I shall therefore only mention one farther advantage which seems peculiar to this mode of counting, a limited number of seconds by a watch, which is, that it is free from any error that might arise from the graduations of a dial plate, or unequal divisions in the teeth of wheels and pinions, where the seconds are counted by a hand.

MISCELLANIES.

Hardening of Steel Dies.—Mr. Adam Eckfeldt is stated to be the first who employed the following successful mode of hardening steel dies. He caused a vessel, holding 200 gallons of water, to be placed in the upper part of the building, at the height of forty feet above the room in which the dies were to be hardened; from this vessel the water was conducted down through a pipe of one inch and a quarter in diameter, with a cock at the bottom, and nozzles of different sizes, to regulate the diameter of the jet of water. Under one of these was placed the heated die, the water being directed on to the centre of the upper surface. The first experiment was tried in the year 1795, and the same mode has been ever since pursued (at the Mint) without a single instance of failure.

By this process the die is hardened in such a way as best to sustain the pressure to which it is to be subjected; and the middle of the face, which by the former process was apt to remain soft, now becomes the hardest part. The hardened part of the die so managed, were it to be separated, would be found to be in the form of a segment of a sphere, resting in the lower softer part as in a dish; the hardness, of course, gradually decreasing as you descend towards the foot. Dies thus hardened preserve their forms until fairly worn out.—*Franklin's Jour.* i. 98.

Cutting of Steel by Iron.—Having occasion a short time since to cut a plate of cast-iron, three-eights of an inch thick, it was thought that the plan recommended for cutting steel by iron might succeed in this case. Accordingly a disc of sheet iron was placed on an axis, and adapted to a water-lathe, in a manner to revolve with great rapidity. This disc would cut hardened or soft steel, or wrought-iron, with much facility, but produced not the slightest effect on the cast-iron, though the latter was very grey and soft. I confess I am quite at a loss to explain this difference in the action of the disc.—Extract from a letter written by Mr. Dolittle, Bennington Iron Works, Jan. 1826.—*Sill. Jour.* x. 397.

Iron-Wire Suspension Bridge, at Geneva.—A second suspension bridge has been constructed, at Geneva, of iron wire, as successfully as the first. It extends in the same manner over the ditches of the fortifications; its length is 82 metres (269 feet,) that being however, divided into two portions by an intermediate support of masonry. Its width is two metres (6.56 feet.) It descends from the town side outwards, and also passes obliquely at an angle of 60° from the abutments, circumstances which raised the expense to 30,000 francs. The suspension cables are four in number, and contain each 135 wires running the whole length; the wires are held at the extremities in a hollow cone, and the flexure of the cables is one-twelfth of the distance between the points of attachment. The bridge when finished, was laden for trial, with stones, timber, &c., equal in weight to that which would have been occasioned by covering it with people, which trial it bore without the slightest derangement.—*Bib. Univ.* xxi. 74.

Iron-Wire Suspension Bridge across the Rhone.—A bridge of this kind has been constructed by M. Seguin across the Rhone, between Tournon and Tain. A mass of masonry has been raised in the middle of the river upon piles, and on each bank has been constructed a strong abutment in stone. These erections divide the width of the river into two equal parts of 100 metres each (328.1 feet,) and upon each of them has been raised a thick support, of a height so calculated as to bear the two ends of the chains on which the platform of the bridge rests, suspended by six bundles of iron-wire on each side, arranged one above the other in vertical planes, at a distance equal to the width of the bridge. The wires are a line in diameter, and each bundle or cable contains 100 wires; from each cable descends vertical bundles of sixty wires each; which at every metre supports the pieces of wood, on which is placed the platform of the bridge.

The platform is sufficiently wide in the middle to allow the free passage of a carriage of the largest size, and on each side is a foot-path of thirty inches wide. At the distance of twenty metres from the central pile, the road-way gradually widens, so that, when over the masonry, it is competent to contain two carriages at once, and thus facility is afforded for the passing of carriages on the bridge, without permitting more than one at a time on the suspended part.

The end of each cable, after having passed over the supports at the extremities of the bridge, descends along the masonry, and is made fast to strong imbedded cast iron-iron plates. The cables which proceed from Tournon rise before the town, pass over the support, and having crossed it, are made fast to it on the Tain side; and those cables which pass from Tain are in like manner made fast to the central pile on the Tournon side. The bridge was opened to the public on September 1, 1825.—*Bib. Univ.* xxi. 84.

Action of Sulphur on Sulphuretted Hydrogen.—M. Dumas has pointed out an important action of sulphur on sulphuretted hydrogen, which, as it effects the results of certain analytical processes, should be clearly known to all chemists. It is usual to analyze carburetted hydrogen and phosphuretted hydrogen gases, by heating sulphur in them, and estimating the quantity of sulphuretted hydrogen produced, the affinities being such as to cause replacement of the carbon or phosphorus by the sulphur. He found, however, that sulphuretted hydrogen was itself affected, and changed in volume by heated sulphur; 100 parts by degrees being diminished even to 90. Hence the indication of hydrogen in this way becomes erroneous and the process must be declared a bad one.—*Ann. de Chim.* xxxi. 116.

Brugnatelli's Process for obtaining Lemon Juice of a strong quality.—Having observed, in the course of several experiments, that the slimy substance in lemon juice separates itself spontaneously from that acid, I endeavoured to find out some method of preventing it from spoiling during the time necessary for its separation, in order that the acid should not acquire any bad properties which might render it unpleasant to the taste, or uncertain in its chemical effects.

I expressed in the common manner the juice of perfectly ripe lemons, and strained it through a piece of linen. In half an hour I strained it again, to free it from a little slimy water which had settled at the bottom of the vessel. I then added to the juice a certain quantity of the strongest spirit of wine, and preserved the mixture for some days in a well-corked bottle. During that time there was a considerable deposit, which to all appearance was of a slimy nature, and which I separated by filtering paper. If the fluid was too thick to pass through the filter, I diluted it again with spirit of wine. After this operation, the deposit remained on the paper, which was entirely covered with it, and I obtained in the vessel placed below, the purest acid of lemons combined with spirit of wine.

If it be required to obtain the acid perfectly pure, nothing is necessary but to separate from it the spirit of wine, which can be best effected by evaporation. The acid of lemons assumes, after it has been freed from the spirit of wine and the moisture combined with it, a yellowish colour, and becomes so strong, that, by its taste, it might be considered as a mineral acid.

It is not necessary to evaporate the spirit of wine in a close vessel, if the experiment is made only on a small scale; nor is there any danger that in open vessels any of the acid will be lost, as it is too fixed to be volatilized by the same degree of heat at which spirit of wine evaporates. This acid has peculiar properties, which deserve further elucidation.—*Ann. de Chim.*

Hatching Fish.—The Chinese have a method of hatching the spawn of fish, and thus protecting it from the accidents which usually destroy so great a portion of it. The fishermen carefully collect, on the margin and surface of waters, all those gallatinous masses which contain the spawn of fish; when they have a sufficient quantity, they fill with it the shell of a fresh hen's egg, which has been previously emptied, stop up the hole, and put it under a sitting fowl. After a certain number of days, they break the shell in water warmed by the sun; the young fry are presently hatched, and are kept in pure fresh water till they are large enough to be thrown into the pond with the old fish. The sale of spawn for this purpose, forms an important branch of trade in China.

Fluidity of Sulphur at common temperatures.—Having placed a Florence flask containing sulphur upon a hot sand-bath, it was left to itself. Next morning, the bath being cold, it was found that the flask had broken, and in consequence of the sulphur running out, nearly the whole of it had disappeared. The flask being broken open, was examined, and was found lined with a sulphur dew, consisting of large and small globules intermixed. The greater number of these, perhaps two-thirds, were in the usual opaque solid state; the remainder were fluid, although the temperature had been, for some hours, that of the atmosphere. On touching one of these drops, it immediately became solid, crystaline, and opaque, assuming the ordinary state of sulphur, and perfectly resembling the others in appearance. This took place very rapidly, so that it was hardly possible to apply a wire or other body to the drops quick enough to derange the form before solidity had been acquired; by quick motion, however, it might be effected, and by passing the finger over them, a sort of smear could be produced. Whether touched by metal, glass, wood, or the skin, the change seemed equally rapid; but it appeared to require actual contact; no vibration of the glass on which the globules lay, rendered them solid, and many of them were retained for a week in their fluid state. This state of the sulphur appears evidently to be analogous to that of water cooled in a quiescent state below its freezing point, and the same property is also exhibited by some other bodies, but I believe no instance is known where the difference between the usual point of fluidity and that which could thus be obtained is so great: it, in the present instance, amounts to 130°, and it might probably have been rendered greater if artificial cold had been applied.—M. F.

Influence of Sugar in the Precipitation of Iron by Ammonia.—The power possessed by tartaric acid of precipitation of iron from its solution in muriatic acid by ammonia, is now well known, from the observations of M. Rose and others. M. Peschier has remarked a similar effect produced by sugar. Peroxide of iron being dissolved in nitro-muriatic acid, with the addition of sugar; ammonia, on being added, produced no effect. A solution of iron in muriatic acid to which sugar had been added before ebullition, presented the same appearances with ammonia; but if the muriate of iron and sugar had not been boiled together, then the ammonia precipitated the oxide. Gum Arabic, which scarcely differs from sugar in its composition, has not this property.—*Annales de Chimie*, xxxi. 297.

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> " Already have we dar'd,
> To pierce philosophy's retreats,
> And teach."—*Akenside.*

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PRINTING PRESSES INVENTED BY MESSRS. APPLEGATH AND COWPER.

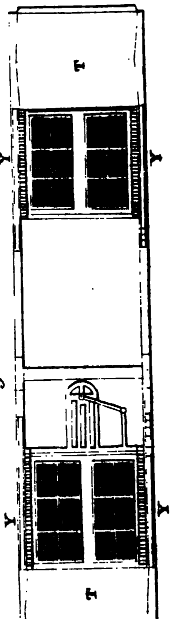

Fig. 3.

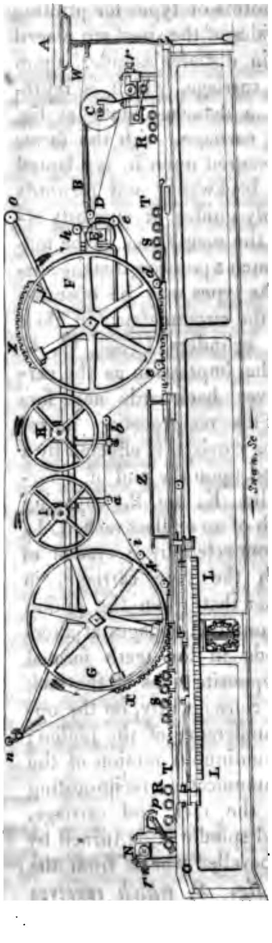

Fig. 2.

PRINTING PRESSES.

(Continued from page 342.)

The cylinders, P, G, H, and I, as also the roller E, are connected by toothed wheels, as represented in the perspective view, fig. 1, so as to cause their circumferences to move with one uniform velocity, and thereby prevent any sliding or shifting of the two systems of tapes over each other during their motion, as much of the perfection of the printing depends upon this circumstance. The separate forms of types for printing the two sides of the sheet are placed at a certain distance asunder, upon one long carriage, which is represented in a detached state at fig. 3. This carriage, with the forms of type secured upon it, is adapted to move backwards and forwards upon steady guides or supports attached to the main frame of the machine, in such a position that the surfaces of the types may be operated upon by the circumference of their respective cylinders F and G, to produce the impression as the carriage moves backwards and forwards. This reciprocating movement of the carriage is effected by a pinion fixed upon the end of a vertical spindle, K, fig. 2, engaging in the teeth of an endless rack, L L, which is connected by a system of levers with the type carriage, in such manner that when the pinion is turned round, it engages at alternate periods in the teeth formed upon the opposite sides of the rack L L, and, consequently, on the opposite circumference of the pinion; thereby a continuous motion of the pinion communicates a reciprocating motion to the rack and carriage. The vertical spindle K, is turned by a pair of bevelled wheels from the pinion P, fig. 2, which receives its motion by an intermediate wheel, Q, from the toothed wheel upon the end of the main cylinder G.

The mechanism for furnishing and distributing the ink upon the surfaces of the types in this machine, is very ingeniously arranged, and performs its operations with great certainty. It is one of the most important points, and the most difficult to effect in printing machines. Two similar and complete systems of inking apparatus, one situated at each end of the machine, are adapted to ink their respective forms of types; we will therefore describe, by reference to fig. 2, the inking apparatus situated at the right hand end of the machine. It consists of a cylindrical metal roller, N, which has a slow rotatory motion communicated to it by a catgut band passing round a small pulley, upon the end of the axis of the main cylinder, G. The roller, N, is adapted to carry down a thin film of ink upon its circumference, by turning in contact with a mass of ink disposed upon a horizontal plate of metal, the edge of which plate is ground straight, and fixed by screws, *r*, *r*, at a small adjustable distance from the surface of the said roller. V represents an elastic composition roller, which is mounted upon a frame turning in an axis, *p*, extending across the main frame of the machine. This roller is connected by cranked-levers, with a small eccentric circle fixed upon the end of the axis of the cylinder G, (as seen in fig. 1,) which causes it to move round the axis, *p*, and remain for a short period in contact with the surface of the ink-roller N, (as seen by the position at the left hand end of the machine, fig 2.)

thereby receiving a portion of ink upon its surface; it then descends and rests with its whole weight upon the surface of a flat metal plate or table, T, which is affixed to the type carriage, as seen in fig. 3; so that the reciprocating motion of the carriage causes the ink-table, T, to receive ink upon its surface from the elastic roller V. In this situation, when the type carriage returns, the surface of the table T is obliged to pass under three small elastic rollers seen at R, which are mounted upon pivots in a frame, with liberty of motion up and down, in order that the rollers may bear with their weight upon the surface of the table.

The frame in which they are centered has also a slight end motion given to it by the inclined form of the end of the table T, (as seen in fig. 3,) bearing against a roller fixed upon the said frame. Thus the small composition roller R, operates in a very complete manner to equalize the supply of ink over the surface of the table T, and by the farther motion of the type carriage, the ink-table is caused to pass under four small elastic rollers (seen at S), which, in like manner, bear with their weight upon the surface of the table (but without end motion), and thereby take up the ink upon their circumferences. The type carriage then returns, for the table T to receive a new supply of ink, and by the form of types passing under the elastic rollers, S, the letters become inked in a very perfect and uniform manner. Whilst the operation of inking the types is going on at one end of the machine, the printing is performed at the other end on one of the sides of the sheet from the types last inked, and *vice versa*. The type carriage is caused to move steadily along with the circumferences of the cylinders F and G, by having racks, *y y*, formed on each in fig. 2), which engage with sec- side of the forms of types (as seen tors, or portions of toothed wheels, *x x*, upon the ends of the said cylinders; at which part the surfaces of the cylinders are covered with a blanket or felt, to give elasticity, and cause them to press equally upon the paper, as in ordinary printing presses.

The machine is put in motion by a strap, *y y*, passing round a pulley, X, as seen in fig. 1, upon the axis of which a pulley or pinion is fixed, engaging with the teeth of the large wheel upon the end of the main cylinder G. Thus the various cylinders, with their two systems of tapes, are caused to revolve with an uniform movement in the direction of the arrows (seen in fig. 2), whilst the type-carriage travels alternately backwards and forwards upon its guides, as before mentioned.

The operation of printing is performed as follows:—The sheets of blank paper are laid, one by one, upon the table B, so as to bear upon the linen tapes which extend over its surface. In this situation, the rollers C and D are caused to move a portion of a revolution, by the operation of a lever fixed upon the axis of the roller D, being acted upon by another lever fixed on the cog-wheel of the main cylinder, F. This motion advances the sheet of paper sufficiently to enable it to be seized between the two systems of endless tapes at the point where they meet each other, or between the rollers *h* and E. As soon as the sheet of paper is carried clear off the table B, the rollers C and D are caused to turn back again to their original position, by the operation of a weight, W, and cord *w*, as seen in fig. 2, ready to advance a second sheet of blank paper into the machine. The sheet of paper is carried along between the system of tapes, and applies itself to the circumference of the main cylinder, F, upon the blanket before mentioned; and by the continuous motion of the cylinder, the sheet of paper is pressed upon the surface of the form of types as they pass under the cylinder by the reciprocating motion of the carriage.

By this means, one of the sides of the sheet receives its impression at the same time that the form of types situated at the opposite end of the carriage is receiving the ink, as before described. Now, by the continuous motion of the machine, the sheet of paper advances in company with the endless tapes, round the intermediate cylinders, H and I, until it applies itself to the blanket upon the surface of the main cylinder G; at which place it will be found in an inverted position, so that the printed side of the sheet is in contact with the blanket and the blank side of the sheet downwards, which, upon meeting with the other form of types at the proper instant, is pressed upon their surface sufficiently to produce the impression. Thus having arrived at the point *i*, where the two systems of tapes separate, the printed sheet is delivered upon the board Z, where it is received by a boy, and laid upon the pile.

Engravings of this machine have appeared in several periodical publications, and in the Supplement to the Encyclopædia Britannica, in all of which it is called "Bensley's Printing Machine." This is a mistake, as Applegath and Cowper are the original inventors and patentees of the identical machine from which those engravings were made. It must have been merely from the circumstance of its being in Mr. Bensley's office that his name has been erroneously affixed to it.

With these machines are now printed, the Morning Chronicle, English Chronicle, St. James's Chronicle, Whitehall Evening Post, Morning Herald, Examiner, Sunday Times, Bell's Messenger, and John Bull newspapers. The machine by which the Morning Herald is printed throws off 2400 newspapers per hour, printed on one side; which is the customary way of printing newspapers, in order to allow time for the other half of the paper to be composed.

(In our last, the figs. 3 *and* 4 *spoken of, should have been fig.* 2 *and* 3.)

ON THE USE OF POWDERED CHARCOAL FOR THE CURE OF WOUNDS AND SORES, AND AS A PRESERVATIVE AGAINST CONTAGION IN HOSPITALS.

By M. Carros, Engineer.

M. de Saussure has proved by his experiments that charcoal acts upon gases, of whatever nature they may be, only by condensing them into itself, often in the proportion of more than thirty times its volume. He has observed that charcoal, saturated with any kind of gas, can*not condense* another without giving up part of that with which it was previously saturated.

These absorbing and disinfecting properties of charcoal serve to explain its action upon the pestilential gases and corrupted matters. Thus charcoal purifies putrid water, because it possesses the faculty of condensing a very great proportion of the pestilential gases, generated by their putridity. When employed in this manner, the charcoal, previously saturated with atmospheric air, quits the latter, and seizes in a much larger proportion the putrid gases generated by corrupted water.

The same phenomenon takes place when charcoal is applied to purulent and fetid ulcers. It instantaneously destroys the infectious and pestilential effluvia profusely emitted by them. Its contact absords the putrid gases of wounds, which are there formed in great quantity by the corruption of the humours and of the flesh.

It is worthy of remark, that this effect produces two important advantages. In the first place, it stops the emission of contagious principles, with which the air soon becomes charged, and which fatally affect those who are obliged to dress putrid sores. Thus, in this point of view, charcoal must be considered as a preservative against contagion.

The second advantage arising from the use of it is, that it accelerates the healing of wounds. It is indubitable, that the mere faculty of taking away the putrid gases which are generated in purulent sores, efficaciously concurs in arresting the progress of the disorganization of the animal substance, which the hydrogen gases have the faculty of attacking in a very active and well-known manner. With this certainty it is very easy to explain the reason why corruption generates corruption, and why charcoal instantaneously checks its progress.

It is likewise possible, that charcoal acts upon wounds as a sort of tonic, and that in clearing away the contagious germ, which tends to devour the flesh, it imparts to the latter an energy sufficient to enable it to form anew, and to cicatrize speedily: for it is fully ascertained, that powdered charcoal applied to a wound when just made contributes to the stanching of the blood and the junction of the flesh. We have, moreover, shown, that it prevents the formation of pus; whence it follows, that it ought to be introduced into the first dressing on a field of battle.

Medical men, who have applied powdered charcoal to the healing of wounds and ulcers, have remarked, that it frequently acted too promptly, by causing them to heal externally in too short a time. Others have denied, without assigning any reasons, that charcoal possessed any sanative properties, though these properties are the necessary results of its faculty of absorbing gases. Lastly, some have advanced, that it encrusted wounds to their prejudice, and others again have even denied it the faculty of purifying corrupted water.

To all this the author answers, that different kinds of charcoal possesses very different qualities, with which it is of importance to be thoroughly acquainted. Some have a much more powerful action than others; and in general the charcoal of the hard wood has the faculty of absorbing a larger quantity of gas than that of the light ones.

The author, in consequence, recommends the use of the most active charcoal, as a less quantity may be applied, and if requisite between two rags. According to this method of opposing the emanation of putrid gases, there would be no necessity to employ it in the form of a fine powder; it might be tried, granulated, and sprinkled upon a slight layer of lint, and more frequently changed.

At any rate it is requisite that

it should be thoroughly charred in contact with the air; and that before it is broken in pieces it should be well cleaned from ashes. It must likewise be kept very dry, since it strongly attracts damp.

Again, it would be well to examine, whether it would not be advantageous to wash it with pure water before it is pounded, and then to dry it well; for it contains certain saline principles in very small quantity, which add nothing to its absorbing faculties, and which certainly do not impart its sanative properties.

The concurrence of fumigations with oxygenated muriatic gas, for the purpose of purifying the atmosphere of hospitals, will serve efficaciously to destroy the pestilential emanations which may not be absorbed by the charcoal, and consequently to prevent contagion.

UNIVERSAL MECHANISM.

TO THE EDITORS OF THE GLASGOW MECHANICS' MAGAZINE.

In No. CXXXII. of the Glasgow Mechanics' Magazine, published 1st July last, appeared an article headed "Mechanism," and signed "Curiosus." The object which the writer of this article seems to have in view is the establishing of the vague theory of *universal* Mechanism. It is no doubt very pleasing at all times to observe the progress daily making in the arts and sciences, and the ingenious and often striking displays of the workings of the human mind, in the discovery of truth, and the pursuit after knowledge. But it is at the same time proper that our admission, approbation, and receiving of any theory, be founded upon the clearest demonstration, and in consistency with every principle of truth and reason. In the article above alluded to, the writer believes "that mechanism is more or less exhibited in every class or species of existence, animate or inanimate;" and by mechanism he understands, "every thing is mechanical in so far as it exhibits works of contrivance." Upon this principle of belief he appears to consider that "all nature" was *contrived* and *executed*, in respect of a *design* emanating from intelligence; and the same reasoning which can be exercised upon a *watch* the contrivance of man, is applicable to *infinite* wisdom, and *all-mighty power!* Now in regard to this article, (but we would wish to be considered as speaking with all deference,) we dissent entirely from the reasoning therein employed; and from this simple cause, that in the Pentateuch, wherein the sacred history describes the creation of all things, we are informed that it emanated *not* from contrivance and design, and was the effect of a mechanical process, which would imply the idea of labour and exertion,—but, simply, "and God said," "and it was so." Hence, the idea either of "Contrivance" or "Design," or any mechanical process, is completely excluded. Perhaps this thought may never have occurred to "Curiosus," but we would recommend it to his consideration, as it appears to us to knock his *curious* reasoning on universal mechanism, and "all nature" having a mechanical appearance, and evincing "proofs of mechanism," —quite on the head.

Simplex.

ON THE PURIFICATION OF SALT.

GENTLEMEN,—Lately while in search of a process for disengaging marine salt *(Muriate of Soda)* from impurities, I happened to fall upon the following, taken from the *Bibliotheque Physico-Economique*, and as I do not think it is generally known to be—what I found it on experiment—a very useful and efficacious plan, I resolved on transmitting it to you for insertion in your useful little work.—I am, GENTLEMEN, Yours,

AN OPERATIVE CHEMIST.

THE muriate of soda is naturally without colour when it is obtained by the evaporation of salt water; and if that of commerce is often grey or yellowish, that hue is owing solely to the small portion of earth taken up with it from the bottom of the salt marsh where it is collected; and the extraction of this earth does not injure the qualities of the muriate of soda.

For this purpose it is sufficient to wash the muriate of soda; but as fresh water melts the salt, it is necessary, in the first place, to procure a water saturated with the same salt, which afterwards serves to wash any that may have to submit to that operation.

It is well known, that fresh water becomes saturated by a solution of 32 parts of salt in 100 parts of water. Take salt, however impure, and decant or draw off the water after it has deposited the earth. For this purpose tubs or troughs may be used, and the water drawn out by means of holes and spigots inserted at different heights.

Put the salt to be purified in a wooden tray, suspended in the tub or trough, and stir the contents of the latter till the earth is so much divided as to remain in solution in the water: it soon settles to the bottom. Repeat the operation as often as may be necessary, and it will be advisable to have more than one tub for the reception of the water that has been run off from the first after the precipitation of the earth.

In this manner, at salt-works in the South of France, I rendered saleable such salt as was before rejected as lying too thin, and on account of the too great quantity of earth which would necessarily be taken up with it if collected; and I increased the produce of the works, to the great advantage of the proprietors.

The salt which has served to saturate the water requisite for washing is not lost; it may be re-produced of a brilliant white, but in powder, by evaporating the water by means of fire, or by the heat of the sun, and this is the only expense incurred, as the labour is very trifling.

This process may be employed on a large as well as on a small scale. The sagacity of the reader will render it superfluous to enter into the minute details requisite for a precise description of the operation. I shall likewise abstain from touching upon the chemical detail of the decomposition of the earths and extraneous salts which it may embrace, as the sulphate of lime, sulphate of soda, magnesia, &c. which are contained in the precipitate that is deposited, and separate from the marine salt, which thus becomes more pure and wholesome.

TABLES OF THE NEW WEIGHTS AND MEASURES

FOR THE BRITISH EMPIRE,

BY R. WALLACE, A. M. PROFESSOR OF MATHEMATICS, ANDERSON'S INSTITUTION, GLASGOW.

(Communicated by the Author.)

I. LONG MEASURE.

STANDARD—The length of the Pendulum vibrating seconds of Mean Time in the Latitude of London at 62° of Fahrenheit's Thermometer, and in a Vacuum at the level of the Sea, is equal to 39.1393 inches of the Brass "Standard Yard of 1760," or "Imperial Standard Yard."

				Pendulums.
$\frac{1}{39.1393}$th of the Pendulum	=	1 Inch	=	.025550
12 Inches	=	1 Foot	=	.306597
3 Feet	=	1 Yard	=	.919792
5½ Yards	=	1 Pole or Perch	=	5.058854
40 or 220 Yards	=	1 Furlong	=	202.354156
8 Furlongs or 1760 Yards	=	1 Mile	=	1618.833244

N.B.—The English Land Chain = 22 yards or 66 feet, and contains 100 links; 1 link = 7.92 inches.

II. SQUARE OR SUPERFICIAL MEASURE.

STANDARD.—The same as in Long Measure.

				Square Pendulums.
$\frac{1}{1531.8488}$th of the Square Pendulum	=	1 Square inch	=	.000653
144 Square inches	=	1 Square foot	=	.094002
9 Square feet	=	1 Square yard	=	.846017
30¼ Square yards	=	1 Square pole	=	25.592003
40 Square Poles or 1210 Sq. yds.	=	1 Rood of land	=	1023.680107
4 Roods or 4840 Square yds.	=	1 Acre of land	=	4094.720426

N. B.—The Square Chain = 484 Square yards, and 10 Square Chains = 1 Acre.

III. CUBIC OR SOLID MEASURE.

STANDARD.—The same as in Long Measure.

				Cubic Pendulums.
$\frac{1}{59956.8989}$th of the Cubic Pendulum	=	1 Cubic inch	=	.0000176
1728 Cubic inches	=	1 Cubic foot	=	.0288207
27 Cubic feet	=	1 Cubic yard	=	.7781587

N.B—A Cubic foot of distilled water at 62° Fahrenheit, weighs almost *exactly* 997.136969 Ounces Avoirdupois, and at the maximum density 999.2777 Ounces Avoirdupois.

IV. TROY WEIGHT.

NDARD.—One Cubic Inch of distilled water at 62° Fahrenheit's
meter, the Barometer being at 30 inches, weighs 252.458 *Troy*
One Pound = 5760 Grains.

			Cubic inches of water.
th of a Cubic inch of water	= 1 Grain	=	.0039610571428
Grains	= 1 Pennywt.	=	.0950653714285
Penny weights	= 1 Ounce	=	1.901307428571
Ounces	= 1 Pound	=	22.815689142857

—A cubic inch of distilled water at the maximum density, weighs
oy Grains.

V. AVOIRDUPOIS WEIGHT.

NDARD.—The same as in Troy Weight; and One Avoirdupois
= 7000 *Grains Troy.*

			Cubic inches of water.		New Gallons of water.
rains	= 1 Dram	=	.10831015625	=	$\frac{1}{2560}$
rams	= 1 Ounce	=	1.7329625	=	$\frac{1}{160}$
unces	= 1 Pound	=	27.7274	=	$\frac{1}{5}$
ounds	= 1 Quarter cwt.	=	776.3672	=	2
uarters	= 1 Hundred wt.	=	3105.4688	=	$11\frac{1}{5}$
wt.	= 1 Ton	=	62109.3760	=	224

—175 Troy Pounds = 144 Avoirdupois Pounds; and 175 Troy
= 192 Avoirdupois Ounces.

VI. IMPERIAL GALLON MEASURE.

ALL SORTS OF LIQUIDS, CORN, AND OTHER DRY GOODS.

NDARD.—Ten pounds Avoirdupois or 277.274 cubic inches of
l water (at 62° Fahrenheit's Thermometer, the Barometer being
nches) are the contents of the New Imperial Gallon.

			Pounds Avoirdupois of water.		Cubic inches of water.
Avoirdupois of water	= 1 Gill	=	$\frac{5}{16}$	=	8.6643125
ls	= 1 Pint	=	$1\frac{1}{4}$	=	34.65925
ts	= 1 Quart	=	$2\frac{1}{2}$	=	69.3185
arts	= 1 Gallon	=	10	=	277.274
llons	= 1 Peck	=	20	=	554.548
cks or 8 Gallons	= 1 Bushel	=	80	=	2218.192
shels	= 1 Quarter	=	640	=	17745.536

—The Proportion of the Imperial Gallon to the Wine Gallon is
5 nearly, to the Ale Gallon as 59 to 60 nearly, and to the Corn
as 33 to 32 nearly; its proportion to the Stirling Pint is as 59 to
rly.

VII. HEAPED MEASURE.

For Coals, Culm, Lime, Fish, Potatoes, Fruit, &c.

Standard.—Eighty Pounds Avordupois or 2218.192 cubic inc of distilled water at 62° Fahrenheit's Thermometer, the Barometer be 30 inches, are the contents of the New Bushel, which is to be m "round with a plain and even bottom, being 19½ inches from outside outside," and to be heaped in the form of a cone to the height of 6 incl

Pounds Avoirdupois of water. Cubic inches of w

8 Imperial Gallons = 1 Bushel = 80 = 2218.192
3 Bushels = 1 Sack = 240 = 6654.576
12 Sacks = 1 Chaldron = 2880 = 79854.912

N.B.—The depth of the Imperial Bushel, is required by the Act, be 8 inches, though this is not expressed; because the height of the h or cone is 6 inches, and this must be equal to three-fourths of the dep

N.B.—The Proportion of the Imperial Bushel to the Linlithgow Wh Firlot is as 106 to 105 nearly, and to the Barley Firlot as 92 to 1 nearly.

VIII. DIMENSIONS OF THE DRY MEASURES.

Standard.—" The diameter shall be at least double the depth, the height of the cone or heap shall be equal to three-fourths of the dep

Imperial Dry Measures.	Depth.	Inside Diameter.	Outside Diameter.	Thickness at the mouth.	Height of the Heap.	Content when not heaped.	Con wi hea
	Inches.	Inches.	Inches.	Inches.	Inches.	Cub. ins.	Cub
Bushel,	8.00000	18.78925	19.50000	.35538	6.00000	2218.192	2815
Half Bushel,	6.34960	14.91304	15.47716	.28206	4.76220	1109.096	1407
Peck,	5.03968	11.83648	12.28422	.22387	3.77976	554.548	703
Gallon or Half Peck,	4.00000	9.39463	9.75000	.17769	3.00000	277.274	351
Half Gallon,	3.17480	7.45652	7.73858	.14103	2.38110	138.637	175
Quart,	2.51984	5.91824	6.14211	.11194	1.88988	69.3185	87

For the use of coopers, and others, who may have occasion to constr the above measures, we have given, in the following Table, the nearest proximate dimensions to the above exact dimensions, that can be measu on a foot rule, graduated to the sixteenth part of an inch.

APPROXIMATE DIMENSIONS OF THE DRY MEASURES.

Imperial Dry Measures.	Depth.	Inside Diameter.	Outside Diameter.	Thickness at the mouth.	Height of the Heap.	Full or Scrimp.
	Inches.	Inches.	Inches.	Inches.	Inches.	
Bushel,	8	$18\frac{13}{16}$	$19\frac{1}{2}$	$\frac{3}{8}$	6	S.
Half Bushel,	$6\frac{3}{8}$	$14\frac{7}{8}$	$15\frac{1}{2}$	$\frac{5}{16}$	$4\frac{3}{4}$	F.
Peck,	$5\frac{1}{16}$	$11\frac{13}{16}$	$12\frac{5}{16}$	$\frac{1}{4}$	$3\frac{3}{4}$	F.
Gallon,	4	$9\frac{3}{8}$	$9\frac{3}{4}$	$\frac{3}{16}$	3	F.
Half Gallon,	$3\frac{3}{16}$	$7\frac{7}{16}$	$7\frac{3}{4}$	$\frac{1}{8}$	$2\frac{3}{8}$	F.
Quart,	$2\frac{1}{2}$	$5\frac{13}{16}$	$6\frac{1}{8}$	$\frac{1}{8}$	$1\frac{7}{8}$	F.

In this table, the dimensions are so near the truth, that were the Measures made exactly to them, the Bushel would differ from its true content only by about $5\frac{1}{2}$ cubic inches; the half Bushel, by about 2 cubic inches; the Gallon, by about 1 cubic inch; and all the rest, by something less than $\frac{1}{5}$ of a cubic inch. It is well known, however, that it is impossible for coopers to work *exactly* to these or any other dimensions that could be given; but by making the inside diameters and depths as exact as possible, and then tapering the wood on the outside of the measures towards the mouth, till it be of the required thickness including that of the iron hoop, they may be brought within a very small quantity indeed of the true content.

If, when tried by their liquid contents, they be found in any case rather small, it is easy to scoop out as much from the inside as will make them exact. On the other hand, if they be found rather large, a slight quantity planed off the edge all round will render them correct.

TO THE EDITORS OF THE GLASGOW MECHANICS' MAGAZINE.

GENTLEMEN,—As Gaelic Literature is now considerably cultivated in the South of Scotland, in comparison of what it was half a century back, and as the language is an old and valuable relic, that will engage the attention of the antiquarian and philosopher, I do not hesitate to submit to you the following *Celtical Questions*, which constitute one of the most difficult parts of our native mountain-tongue.

C.

TO L. M‘L., ISLAND OF COLL.

SIR,—My object in addressing you at this time, is to lay before you some difficulties in the use and declension of the Gaelic noun, which, from your Ossianic situation, I doubt not but you will be able satisfactorily to answer:

1. When does the substantive assume the aspirating *h*, and when does it reject it?

2. Does the substantive assume the aspirate when by itself, invariably in the same manner as when with an adjective?

3. Is the substantive differetnly aspirated when the adjective immediately precedes it, from what it

is when its adjective follows? and, —4. Is the adjective subject to the same rules of aspiration as the substantive?

By answering the above, you will oblige, SIR, Yours, &c.

CELTICUS.

Glasgow, 20th July, 1826.

MISCELLANIES.

To make Potatoe Bread.—Put a pound of potatoes in a net, into a small kettle with cold water, and (lest the skin break, and let in the water) hang it at a distance (so as not to boil) over the fire till they become soft; then skin, mash, and rub them so as to be well mixed with a pound of flour, a very large spoonful of salt, and two large spoonfuls of yeast; but less of the yeast is better. Then add a little water, and knead it up as other dough; lay it a little while before the fire to ferment or rise, then bake it in a very hot oven.

Economy in Fuel.—Let the coal ashes, which are usually thrown into the dust binn, be preserved in a corner of the coal-hole, and add to them from your coal heap, an equal part of the small coal or slack, which is too small to be retained in the grate, and pour a small quantity of water upon the mixture. When you make up your fire, place a few round coals in front, and throw some of this mixture behind; it saves the trouble of sifting your ashes, gives a warm and pleasant fire, and a very small part of it will remain unburnt.

Excellent Substitute for Table Beer.—As small beer is apt to become sour in warm weather, a pleasant beer may be made, by adding to a bottle of porter, ten quarts of water, and a pound of brown sugar or molasses. After they have been mixed, pour the liquor into bottles, and place them loosely corked, in a cool cellar. In two or three days it will be fit for use. A spoonful of ginger, added to the mixture, renders it more lively and agreeable to the taste.

To remove the taste of Turnips from Milk or Butter.—The taste of the turnip is easily taken off milk and butter, by dissolving a little nitre in springwater, which being kept in a bottle, and a small teacup full put into eight gallons of milk, when warm from the cow, entirely removes any taste or flavour of the turnip.

Chinese method of mending China.—Take a piece of flint-glass, beat it to a fine powder, and grind it well with the white of an egg, and it joins china without rivetting, so that no art can break it in the same place. You are to observe that the composition is to be ground extremely fine on a painter's stone.

Economical mode of cutting Cauliflower.—Instead of cutting off the whole head of a cauliflower, leave a part on of the size of a gooseberry, and all the leaves; second, and even third heads will be formed, and thus they may be eaten for two or three months; when, at present, by cutting the head completely off, the bed of cauliflowers are gone in two or three weeks.

To cure tainted Fish.—Tainted fish may be much restored to its proper flavour by mixing a quantity of vinegar and salt in the water in which the fish is to be boiled.

To keep Moths, Beetles, &c. from clothes.—Put a piece of camphor in a linen bag, or some aromatic herbs, in the drawers, among linen or woollen clothes, and neither moth or worm will come near them.

To prevent Shoes and Boots from taking in water.—One pint of drying oil, two ounces of yellow wax, two ounces of turpentine, and half an ounce of Burgundy pitch, melted carefully over a slow fire. If new boots or shoes are rubbed with this mixture, either in the sun-shine, or at some distance from the fire, with a sponge or soft brush, and the operation is repeated as often as they

dry, till the leather is fully
ed, they will be impervious to
d will wear much longer.

-Shoes or boots prepared as above ought
e worn till perfectly dry and elastic,
e their durability would rather be pre-
han increased.

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to make Great Coats, &c. water-
-Great Coats, and other articles
xposed to the weather, are ren-
oth sun and rain proof, by the
ng excellent varnish; Boil well
r two pounds of turpentine, one
of litharge in powder, and two
e pounds of linseed oil. When
icle is brushed over with this var-
must be dried in the sun; after
the greatest heat will not affect

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toes.—A gentleman near Ren-
as prosecuted an experiment on
ect of pulling the flowers or blos-
rom the Potatoes, with great care
ention, in fields of two acres each
y taking alternate portions of equal
the same field: pulling the blos-
rom some of those divisions, and
others to ripen the seed; attend-
Autumn, when the Potatoes were
up, and measuring the produce
reat care, he uniformly found the
y increase 10 or 15 per cent.
the blossoms were taken off, be-
here being very few small Pota-
the field. He also found the
much improved in consequence
crop ripening sooner than usual,
erefore not affected by the frosts,
often set in so early that the
of the Potatoe is completely
d before it arrives at maturity:
continued the practice for the
e or six years, on fields from four
acres, and considered the experi-
orth prosecuting to any extent:
pence about 3s. per acre, and
by children from ten to twelve
f age.

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edy for Frost-bitten Potatoes.—
itten Potatoes, and all other veg-
, as fruit, &c. are restored to their
l taste and flavour by being steep-
old water twelve hours before they
led. Potatoes are also preserved
ecay in the latter season by being
n a kiln, or any other convenient

Economy in feeding Calves.—From experience it is now perfectly understood by some breeders, that calves suckled upon churned milk, thrive equally well by giving about one-third more, by which all the butter is saved for the market, and there has never been an instance of the calves brought up in this way, either taking the disease of livercrook or mortification.—*Inverness Journal.*

Economy in planting Potatoes.—The common mode of planting potatoes is, by setting the small roots entire; or, by cutting the larger ones to pieces, and reserving one eye or bud to each: it appears, however, that the *rind* may be employed with equal advantage; as crops have thus been produced, which fully equalled those obtained from seeds, sets, shoots, or by any other method.

Mr. Millington's Method of preserving Potatoes.—According to his statement, three pounds of potatoes were peeled, rasped, and put in a coarse cloth between two boards, in a napkin press, till they were pressed into a very thin cake, that was placed on a shelf to dry. The roots yielded, on expression, about one quart of juice; which, being mixed with an equal quantity of cold water, deposited in the course of an hour, upwards of one dram of white flour or starch, in every respect fit for making fine pastry. —Mr. M. presented in 1799 to the "Society for increasing the Comforts, &c. of the Poor," a cake which had been thus prepared in the year 1797: In bulk, it occupied only one-sixth part of the original roots; and lost about two-thirds in weight by the process; but he observes, that such cake, when dressed by steam, or otherwise, will afford nearly the same quantity and weight as three pounds and a half of potatoes, properly boiled.—Some roots, that had been thoroughly frozen, have been managed in a similar manner; and the cake was perfectly sweet; whereas others of the same parcel, that were left unpressed, in a few days became rotten.

Another mode of keeping Potatoes,—Was lately and successfully tried, by the patriotic Bath and West of England Society. It consists simply in slicing potatoes without taking off the rind or skin, and afterwards drying them in an oven or kiln. The roots thus prepared will remain sweet for almost any length of time: the Society sent some to Jamaica in a barrel; which had been *four years* from Britain, and on their return, were found not to be in the least degree affected.

Substitute for Hemp and flax.—As hemp and flax (lint) is now very high-priced, if the public would turn their attention to the Urtica Dioica (common nettle,) an excellent hemp might be obtained from it, by cutting it just before the seed is ripe, and steeping it in water as they do hemp or flax and manufacturing it in the same way.

Other uses of the Common Nettle.—The root of the plant is esteemed to be diuretic, and the roots, boiled with allum, will dye yarn a yellow colour. It is likewise used by making a strong decoction of the young plant, and salt put to it, and bottled up, which will coagulate milk, and make it very agreeable; by which means that plant, which is an obnoxious weed, might be turned to good account.

To prevent Curl in Potatoes.—A farmer states, that it is well ascertained, and proved by documents the most unquestionable, that the cause of curled potatoes is from allowing the crab of the potatoe to remain on the plant; for when the crab has been cut off, the future sets have always proved free from the curl.

It is also necessary that the potatoes for sets should be reaped before the stem is withered. And the matter worthy of remark is, that a green potatoe top cut off in June, at the length of six to eight inches, and pricked into the ground in moist weather, will produce good potatoes in October.

To make Sea Water fit for washing Linens at Sea.—Soda put into sea-water renders it turbid; the lime and magnesia fall to the bottom. To make sea-water fit for washing Linen at sea, as much soda must be put in it, as not only to effect a complete precipitation of these earths, but to render the sea-water sufficiently lixivial or alkaline. Soda should always be taken to sea for this purpose.

Economy in tinder.—The very high price of paper, at present, renders the saving of even the smallest quantity of linen or cotton rags of consequence, as they sell very dear; trifling as it may be thought, a quantity of rags may be saved, by using as tinder for lighting matches, the contents of the common snuffers collected in the course of the evening.

A cheap Blacking for Shoes.—In three pints of small beer, put two ounces of ivory black, and one pennyworth of brown sugar. As soon as they boil, put a dessert spoonful of sweet oil, and then boil slowly till reduced to a quart. Stir it up with a stick every time it is used; and put it on the shoe with a brush when wanted.

Another.—Ivory black, two ounces; brown sugar, one ounce and a half; sweet oil, half a table spoonful. Mix them well, and then gradually add half a pint of small beer.

A Black Varnish for Old Straw or Chip Hats.—Take best black sealing-wax, half an ounce; rectified spirit of wine, two ounces; powder the sealing-wax, and put it with the spirit of wine, into a four ounce phial; digest them in a sand heat, or near a fire, till the wax is dissolved; lay it on warm with a fine soft hair-brush, before a fire, or in the sun. It gives a good stiffness to old straw hats, and a beautiful gloss equal to new, and resists wet.

Substitute for Milk or Cream.—Where cream or milk cannot be got, it is an excellent substitute to beat up the whole of a fresh egg, in a basin and then gradually to pour boiling tea over it, to prevent its curdling, It is difficult, from the taste, to distinguish the composition from tea and rich cream. This might be of great use at sea, as eggs may be preserved fresh in various ways.

How to make Sweet Oil.—This may be done, by grinding or beating the seeds of white poppies into a paste, then boil it in water, and skim off the oil as it rises; one bushel of seeds weight 50 lbs. and produces two gals. of oil.

Receipt for taking a Musty Taste from Casks.—Take out the head of the cask, put on the hoops again, and tighten them, so that the staves may be held closely together from top to bottom, and that no interstice be left between them, lest the fire should injure the surfaces by which they meet. Stop the bung-hole with a wisp of wet hay, without which precaution the flame would pass through and injure the bung-hole.

When the cask is thus prepared and placed on its side, put into it a small quantity of dry chips, set fire to them, and while they are burning roll the cask gently round, that the fire may act upon every part; continue this operation so long as is necessary to consume all the putrid or musty particles, adding more wood if needful.

While one person rolls the barrel from side to side it is proper that another should attend to the fire, keep the burning wood in order, and push it towards the bottom. Without this precaution, the flame always seeking to escape at the open end, would act very little, or not at all, upon the bottom, and injure the groove which receives the head that has been taken out. A stick four or five feet long, and forked at the end, is used for stirring the fire.

This operation being finished, proceed to the head. Take one piece of it after another, and scorch them in a clear flame, holding each piece with the tongs, first by one end and then by the other, so that the particles of mould covered by the tongs may be burned. A small portion of mould, no larger than a shilling, would be liable to communicate a taste to the wine.

When the wood is rotted to a certain depth it is advisable to remove all the rotten part with a scraper before it is scorched.

When there is nothing but mould it may be discovered by the smell, and by small bluish spots on the inside of the cask. A slight application of fire removes all this mould. When the inside is decayed to a certain depth, the operation is longer; but with time and patience, an equally successful result may be obtained. If this cask should take fire it must be quickly turned with the bottom uppermost, when the fire will immediate go out.

The interior surface of all the staves being thus slightly charred, the head must be put on again as usual, and the whole washed till the water from it appears quite clear. Casks treated in this manner never communicate a bad taste to wine.

The best Mode of Lighting a Fire.—Fill your grate with fresh coals quite up to the upper bar but one, then lay in your faggot of wood in the usual manner, rather collected in a mass than scattered, that a body of concentrated heat may be produced as soon as possible; over the faggot place the cinders of the preceding day, piled up as high as the grate will admit, and placed loosely in rather large fragments, in order that the draught may be free—a bit or two of fresh coal may be added to the cinders when once they are lighted, but no small coal must be thrown on at first, for the reason above stated;—and when all is prepared, light the wood, when the cinders become thoroughly ignited, the gas rising from the coals below, which will now be affected by the heat, will take fire as it passes through them, leaving a very small portion of smoke to go up the chimney. —The advantage of this mode of lighting a fire is, that small coal is better suited to the purpose than large, except a few pieces in front to keep the small from falling out of the grate: it may be kept in reserve, to be put on afterwards if wanted. Fires lighted at eight o'clock in the morning, having been frequently known to continue burning untill eleven at night, without any thing being done to it: when apparently quite out, on being stirred, you have in a few minutes a glowing fire:—it will sometimes be necessary to loosen or stir slightly the upper part of the fire, if it begins to cake: but the lower part must not be touched, otherwise it will burn away too soon.—*Medical Adviser.*

Croton Oil Lozenges.—Dr. Seiler, at Hoxter, has been lately induced to try the exhibition of Croton Oil in the form of lozenges. These trotches are made of sugar and a little mucilage of gum-arabic; and each lozenge contains a quarter of a drop of the oil. The lozenge is allowed to be gradually dissolved in the mouth, and it is found to operate as an effectual purgative in about two hours. Three of these taken at short intervals, by an individual, overcame a violent constipation, without producing any nausea, vomiting, or prostration of strength.—*Journal der Practischen Heilkunde.*—This appears a very excellent method for administering this valuable purgative, as the principle objections to its use are the nausea and vomiting which, by the usual mode of taking it, are occasioned.—*Lancet.*

On Metalic Precipitations.—Relative to the peculiar case of the precipitation of copper described by M. Clement, M. Taillefer quotes the following similar instances. A person of Dijon, who separates the metal from the ashes and crucibles of jewellers, gave him some solution in which he suspected a small portion of gold and silver still remained; it appeared, however, to contain nothing but copper in solution in nitric acid: it was left for several days in a large glazed earthen bowl, and then, when decanted, was found to have deposited a network of copper, slightly adherent, and of which the ramifications closely followed the clefts in the glaze. This effect is explained in the following way: the vessel had previously been used in a kitchen, and having been on the fire, the glaze was cracked most at the bottom; these cracks, it is supposed, had by capillary attraction retained animal or vegetable matter, and this, by its action on the solution of copper, had reduced and separated a part of the metal.

The following is another instance of the precipitation of copper without the help of another metal: such instances are, however, sufficiently abundant. Cream of tartar dissolves a large quantity of black oxide of copper; if the solution be diluted, and then heated moderately, there will be deposited, in the course of some hours, a finely-divided red powder, which dissolves in nitric acid, disengaging nitric oxide, and indeed having all the characters of reduced copper. This deposit increases to a certain point, beyond which no further change of the kind takes place; the solution becomes, from concentration, thick, and at last solid.—*Annales de Chimie,* xxxi. 103.

Sulphate in Soot.—M. Braconnet having analyzed several varieties of soot, as that from a wood-fire, lamp-black, &c., concludes, amongst other things, that all soots essentially contain several sulphates. The presence of a notable quantity of sulphate of ammonia, amongst other sulphates, in lamp-black, renders that substance unfit to be used, as has sometimes been done, in the reduction of metals, when it is wished to obtain them pure, and not at all sulphuretted.—*Annales de Chimie,* xxxi. 37.

Preventive of Scarlet Fever.—The *Lancet* informs us of an important medical discovery in Germany. Extract of *belladonna* has been found generally to render persons insusceptible of the fever in places where it is reigning. Medical men of character and in official situations have tried the experiment in various parts of Germany, chiefly by giving the medicine to a number of children as soon as the disease appeared in the place where they lived. In nearly all the cases detailed in thirteen different reports, the children, although purposely allowed to mix with the infected patients, wholly escaped the fever, and in the few who took it, the disease appeared only in a very mild form. The quantity to be given of the extract is a twentieth part of a grain, morning and evening.

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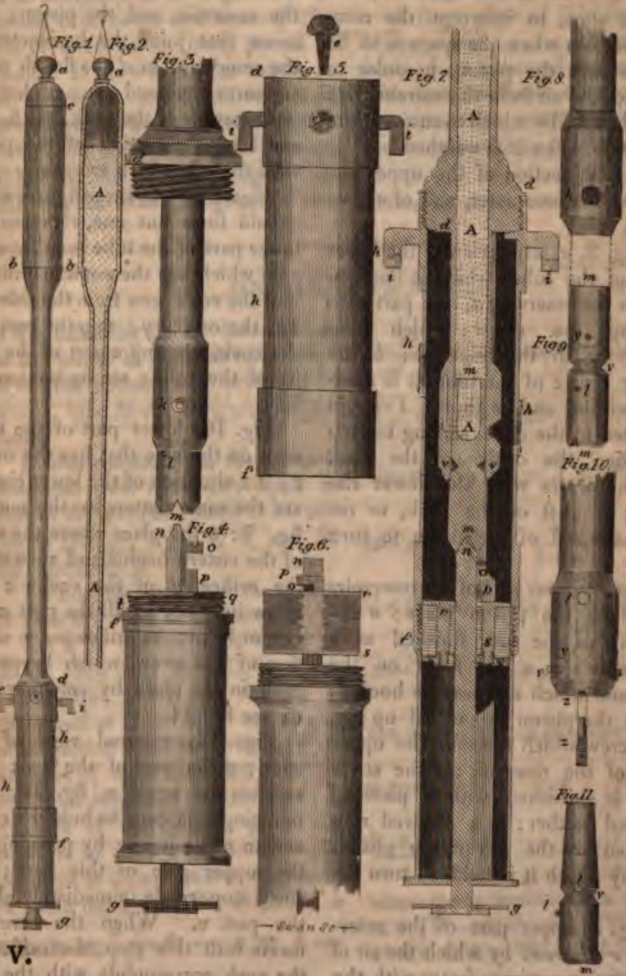
A BAROMETER FOR MEASURING HILLS AND MOUNTAINS.



A BAROMETER FOR MEASUREING HILLS AND MOUNTAINS.

FIG. 1, an external view of the barometer ready for use, with the reservoir affixed to it; *a*, a button with a hole through it for the string by which the instrument is suspended; *c b* the upper cistern; *b d* body of the tube; *e* screw, furnished with a piece of greased leather, to give, when open, communication with the interior of the reservoir; and when shut, to intercept the communication when the space is to be made with the piston, in order to extract the air from the mercury; *i i* two hooks, by which to suspend the reservoir when it is weighed.

Fig. 2, section of the upper cistern of the barometer, and of a part of its tube.

Fig. 3, external view of the lower part of the tube, which is immersed in the reservoir *d*, the part containing the screw which joins the tube to the reservoir: *k* the lower orifice of the tube, it is conical within and without; *l* a pin adapted to the cock, serving to stop it when the orifice of the cock communicates with the lower cistern; *m* cleft of the cock, to receive the rod of the piston to turn it.

Fig. 4, lower part of the reservoir, in which the piston plays; *n* extremity of the rod, finished as a turnscrew; *o* a pin fixed on the rod, and which catches the hook *p*, when the piston is pushed up; *q*, the screw which fits into the upper part of the reservoir: *t* the screw that is furnished with a piece of greased leather; *g* a grooved ring adapted to the rod of the piston, and by which it is held, to turn the cock.

Fig. 5, upper part of the reservoir: *e* a screw, by which the air of the reservoir communicates with the external air; *h h* the glazed apertures, by which the interior of the reservoir may be viewed; they correspond with the two orifices of the tube of the barometer.

Fig. 6, external view of the piston out of the reservoir, the rod *g n* with its pin *o* inserted in the hook *p*.

Fig. 7, section of the lower part of the barometer, with the cock, the reservoir, and the piston; *d*, a screw that joins the barometer to the reservoir; in *d* is a flanch which supports a greased piece of leather; *m m* section of the cock, see figs. 9 and 11; *r s* section of the piston with the rod which crosses it.

Figs. 8 and 9, these figures which should form but one, represent the lower part of the tube seen from the side which has the conical orifice *k*, and the cock seen from the side that has the orifice *y*; *m y* the cavity of the cock, forming a part of the cavity of the tube; see its section fig. 7.

Fig. 10, lower part of the tube, seen on the side that has the orifice *t*; *t z* situation of the lower cistern, see the same letters in the section, fig. 7; *y* the place where the space of the cistern begins and answers to the orifice *y* of the cock; *z* the screw intended to fill the part of the cistern below the orifice *y*; *v* situation of the screw, which keeps the cock in its place by catching it at *v*; see fig. 11.

Fig. 11, external view of the cock; *v* the part of the cock that receives the screw *v*, fig. 10, terminating in a cone to hold the cock, and to make it rise by pressing on the upper side of this part; *l* a small stop, made immediately above the part *v*. When the screw *v* meets with this stop, the orifice of the cock corresponds with the orifice *k* of the tube; *l* a stop pin; when it meets the screw *z*, the orifice of the cock corresponds with the cistern *t y*.

NEW ELECTRICAL PILE.

THIS Electrical Pile is constructed of plates of sheet iron, covered with wax about $\frac{1}{10}$ of an inch in thickness, and the wax is then cooled with tin foil, except about $1\frac{3}{4}$ inches round the edges. The wax is a composition of 1 part of red ochre, 6 of rosin, and about $\frac{2}{3}$ of a gill of sweet oil for every pound of rosin. If the wax be too brittle so as to crack, it would receive a spontaneous discharge of the pile though the crack were at the distance of half an inch from the edge of the foil, a spark would be given off before it is half changed. The wax may be rendered sufficiently tough by means of the oil. These materials are not so expensive as glass, and are easily repaired, and durable, and besides, the wax has not so great an attraction for moisture as glass.

A large plate of this description being placed at the distance of 20 inches from a pointed wire connected with thec onductor of an electrical machine, was sensibly changed in the course of 2 or 3 minutes.

A. B.

Dollar, 8th August, 1826.

ON BARKER'S MILL.

THE following is an investigation of the power of Barker's mill, which is of that construction proposed by Euler, (*see Brcu. Ferguson's Lectures.*

In this construction, the water is conveyed with a velocity equal to that of the circular cistern B D, and passes through tubes to C and E, the apertures.*

To find the height of the fall A B from the canal to the cistern.

Let $h =$ the height A C; $x =$ A B; then $h - x =$ B C, let $V =$ velocity due to h; $v =$ velocity of th ewheel at B or C; $v^1 =$ velocity of projection from the orifice; $g =$ quantity of water supplied in 1″ by the canal expressed in cubic feet; $a =$ area of the orifice; $p =$ the pressure on a, or a column of water of height B C, and base a, expressed in cubic feet; then $V^2, v^2 = h : x$ and $x = \frac{h\ v^2}{v^2} h - x = h - \frac{h\ v^2}{v^2} = \frac{h}{v^2}(V^2 - v^2)\ h : h - x = V^2, v^12$ and $v^1 = V \sqrt{\frac{h - x}{h}}$; also $q = a\ v^1 = a\ V \sqrt{\frac{h - x}{h}}$; and $a = \frac{q}{v} \sqrt{\frac{h}{h - x}}$; then $p = 2\ a\ (h - x) = 2\ q \frac{(h - x)}{v} \sqrt{\frac{h}{h - x}} = \frac{2q}{v} \left\{ \sqrt{h\ (h - x)} \right\}$ and if $m =$ the momentum of the wheel $m = p\ v = \frac{2\ q}{v} \sqrt{\left\{ h\ (h - x) \right\}}\ v = \frac{2\ q}{v} \sqrt{\left\{ \frac{h^2}{v} (V^2 - v^2) \right\}}\ v$ and when the momentum is a maximum so is $(V^2 - v^2)\ v^2$; and $2\ V^2\ v\ d\ n - 4\ v^3\ d\ v = o$; $V^2 - 2v^2 = o$; and

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* The Engraving of this appears at page 387.

$v = \sqrt{\frac{V^2}{2}} = \frac{1}{2} V \sqrt{2}$; hence $x = \frac{h v^2}{v^2} = \frac{h}{v^2} \frac{1}{4} \cdot v^2 \times 2 = \frac{1}{2} \quad h$; and hence $m = q h =$ the whole power of impulsion of the water.

Hence the A B ought to be equal to half the height of the fall, and then the whole power of the water is efficient. If the area of all the apertures be such, that with a velocity due to half the whole height of the fall, the whole supply of water will pass, then the surface of the water in the cistern, will remain constant. If there be a great supply of water, this wheel might be used by making a greater number of tubes and apertures. It exerts the whole power of the water, and when a considerable velocity is required, this is obtained without a train of machinery, from the wheel itself.

A. B.

Dollar, 9th August, 1826.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

SECTION VI.

13. *Straw Bleaching.*—Our milliners not pleased with the yellow colour, which the straw of which hats are made originally, possesses, or urged by the all prevailing passion for novelty, have lately been desirous for obtaining white straw; and several attempts have been made to bleach this substance with the usual agents. Sulphuric acid has been found to succeed best in those incipient attempts, while the oxymuriates and the simple chlorine gas are said to injure the texture and destroy the natural varnish of the straw, which is its greatest beauty. It is probable, however, that this has proceeded from unskillful management, for in other departments of bleaching, the corrosive effects of the chlorine when combined with earths or alkalies, and properly diluted, are found to be as easily prevented as that of sulphuric acid, while its power of destroying a colour is greatly superior.

14. *Silk Bleaching.*—In Hindostan, as we learn from Dr. F. Buchanan, in his journey through the Mysore *(vol. I. p. 223,)* in order to bleach their silks, they take 5 seers (a seer is 4835 lbs.) of silk, either raw or in thread, 3 seers of *soulu*, or in pearl soda, and one and a half of quicklime, mixing the soda and lime with 4 or 5 seers of water. This is boiled for an hour, and the silk dipped into it, and afterwards dried. Then they take 3 seers of this silk, 3 seers of soulu, one dudu (6.47 Dra.) of indigo, and 18 seers of water, and boil the whole for about two hours. The silk is then washed in limpid and hot water, and dried. This process requires much care, as if there be too little soda the goods will be spoiled, and if boiled too little a good white will not be produced.

The Chinese mode of bleaching the silk denominated Nankin, without boiling or ungumming it, is supposed to have been discovered by M. Baume, who has given an elaborate memoir on the subject, *Jour. de Phys.* 1793. M. Baume (loc. cit.) directs to dispose six pounds of yellow raw silk in a stone ware vessel, and to pour over it a mixture previously made of about forty eight pints of spirit of wine, and twelve ounces of very pure muriatic acid, the whole being then covered up and left to digest, till the liquor change from green to yellowish brown. The liquid is then drawn off, and unmixed spirit of wine is poured upon the silk till it come off colourless: it is then allowed to drain or *seep*, as the Scotch bleachers would say when it is ready for a repetition of the process. The second steeping continues longer than the first. The third maceration is made in pure spirit of wine for a day, when it is drained and sprinkled with water to recover all the spirit, it is then washed clear of the acid by putting it in a woollen bag, and keeping it in a running stream for 6 hours. The water and the muriatic acid ought to be completely free from the nitric acid, otherwise the goods will be spoiled. Rigand found the process to be one half speedier when the vessels were exposed to the sun, (*Gay. de Comm. 7th Nov.* 1778.)

When the gum is to be deprived of its gum, the process is different. A ley of white soap is made by boiling in water 30 lbs. of soap for every 100 lbs. of silk intended to be bleached, and in this the silk is steeped till the gum is dissolved and separated. It is then put into bags of coarse cloth and boiled in a similar ley for an hour. By these processes it losses 25 per cent. of its original weight. The silk is then thoroughly washed and steeped in a hot ley composed of a pound and a half of soap, 90 gallons of water, with a small quantity of litmus and indigo is diffused. After this it is carried *to the sulphuring room: Two pounds of sulphur* are sufficient for 100 lbs. of silk. When these processes are not sufficiently successful, it is washed with clear *hard* water and sulphured again, (*Des Charmes* p. 294.)

15. *Wool Bleaching.*—Wool is commonly bleached by means of fumes arising from the slow combustion of sulphurs, by which is meant combustion in the Atmosphere in contradistinction to that of burning in oxygen gas, or by a mixture of nitre. (*see Parkes' Chem. Ers.* iv. 154.) The former, Schiell has shown by luminous experiments, is the most effectual for bleaching wool. The process has been known and practised these sixteen hundred years, as appears from Apuleins, (*De Asins Aures.* ix. 136,) who tells us of a man, that having had an illicit amour, was nearly suffocated in the house of a fuller by hidding under a wicker coop where cloth was hung to be whitened by the fumes of burning sulphur: "*Contigit vinainea cavea; gual lacineas circumates, suffusa candido fumo sulphuris inalbabat.*" It is even mentioned by Pliny (*Hist. Nat.* xxxv. 15.) to have been employed so early as the first century. The wool is first prepared according to the purposes for which it is intended, by treating it with leys composed of wine and water—or of solutions of soap. By this process, it is cleared of a great quantity of loose impurity and grease which is always found in wool, often loosing no less than 70 per cent. of its weight. The heat of the ley must be carefully attended to, as a high temperature is found to fix the unctuous matter or yolk of the wool. After washing, it is taken to the sulphur chamber, where it is exposed to the vapour from 5 to 20 hours according to circumstances. This again washed, and then immersed in a bath composed of pure whiting and blue. It is then expos-

ed a second time to the fumes of the sulphur, and washed with a solution of soap which renders it of the proper whiteness. It is of importance to remark, that there should be no iron about the sulphur chamber, as by becoming oxidized it might spot the goods. The cloth or wool also which has been sulphured, ought not to be laid immediately on wood, as the sulphur will dissolve the resin or gum of the wood, and produce stains. The final washing with soap takes away the harshness of the wool and the disagreeable odour left in it by the sulphur. This mode of bleaching, however, only whitens the surface of the goods, which has led recently to the employment of liquid sulphurous acid. The process of its application has not come to my knowledge. For farther information, consult Pagot, *Des Charmes*, 6. 28.

16. *Wax Bleaching.*—According to Fourcroy, (*Syst. Connais. Chim.* x. 343.) wax derives its yellow colour from the fumes and moisture which proceed from the bodies of the bees in the hive as well as from the colouring matter of the vegetables whence it is derived. This opinion seems to have been formed upon the erroneous notion that wax is derived immediately from pollen, the falseness of which the experiments of Huberson has completely exposed. It is a pure animal secretion. In order to bleach it, pieces of it are melted so as to fall upon a cylinder which is half dipped in cold water, and which, as it rolls by a simple contrivance, it passes successively through this water. The wax is by this means formed into thin ribbons, which are exposed to the sun and air upon cloths, till it acquire the requisite whiteness, when it is improperly called virgin wax. This is the account given by Fourcroy as the French method: Parkes has copied it nearly verbatum, as the method followed in England, (*see Syst. Connais. Chimique.* x. 343. and *Chem. Ers.* iv. 155.) We have a different account of the French mode in Des Charmes: The ribbons of wax he directs to be exposed to the action of water, impregnated with chlorine gas which succeeds better than any of the oxy-muriates.

We have in the Annale de Chimie (No. 131.) a very curious account by M. Cadet of the mode of bleaching the vegetable wax produced from the *Myrica cerifera* of America. It is effected by the sulphuric acid or chlorine; but as the wax does not sink in those fluids, means have to be invented to multiply the contact either by cutting the wax into slices, and be-sprinkling it with the liquids, or shutting it up, when sliced, in a cask into which they are introduced. A speedier method would be to place the wax cut into small pieces in alternate strata with the oxy-muriate of lime, leaving it in this state for some time dry and in contact. The salt and acidulous water are then to be decomposed by sulphuric acid, pouring in the water gradually, till no more muriatic gas be disengaged. Add then a large quantity of water, stir the mixture, and the insoluble sulphate of lime will fall to the bottom, while the bleached wax will float on the surface.

ON RAILWAYS, &c.

GENTLEMEN,—The following letter on a very important subject was recently sent me from America. If you think it likely to prove at all interesting to any of the readers of your useful Little Work, you are extremely welcome to it. It may elicit some useful discussions.—I am, GENTLEMEN,

Yours, &c.
R. WALLACE, Jun.

33, George's Square, August 7th, 1826.

RESIDING in this place, and being engaged in pursuits where both interest and inclination, make information on mechanical and philosophical subjects desirable, a friend of mine, now in Great Britain, lately transmitted me three numbers of your Magazine, and writes, that the leading article of interest to me will, he supposes, be "The improved method of metalic packing, for Steam Engines by Mr. Snodgrass," consisting of hempen packing behind a brass ring. This mode has been used here for several years, and found to answer a good purpose, except when the water contains much sand or other earthy particles.

I observe by these numbers, (say of June, July, and August last,) that Railways, and the merits of steam power to be used on them, continue to occupy much of the public attention. I have seen some previous pieces on the subject: the first, from the "London Magazine and Review for January 1825," in which the fallacious doctrine of the operation of the steam engine is laid down, and which forms the basis of that writer's arguments, and continues to do so, with all his successors on that subject.

It is stated by way of hypothesis, "that if a force of 1000 lbs. be equal to the friction of a carriage on a railway, it is held in equilibrium, and that any additional force will make it move; and if this additional force be continued, a constant and gradual acceleration of velocity will take place, as the inertia of the body from a state of rest to motion, is overcome." "Hence (as one winter day,) on a railway, the expenditure of force due to a velocity of 10 or 12 miles an hour, is very little more than that due to a velocity of 2 miles an hour." In the Scots Magazine for June it is said: "In like manner, if the inertia of a body be overcome, and if it be once put in motion on a railway at a certain velocity, the same constant force which would cause it to move at the rate of 2 miles an hour, will also be sufficient to cause it to run at the rate of 20 miles an hour, or any other rate that can be obtained."*

In the same number, another writer treating on the same subject, after a satisfactory experiment (to him) of a weight attached to one end of a rope, passing over a pulley to a carriage at the other end, on a level railway, and finding that the velocity of the carriage, obeyed the laws of falling bodies—remarks—"Let it be observed however that the above example will only hold good, when the resistance of the atmosphere is not taken into account, and as it will be a difficult task to remove it, we must, in calculating the power to propel carriages on railways, deduct as much power as is equal to the resistance of the atmosphere."

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* What is said in this quotation is correct in the letter, but by a perusal of the article from which it is taken, it will be seen that the writer had no idea that the "constant force" cost more at one velocity than at another, he says,—"It was supposed by most early writers no Mechanics, that the retarding force of a body in motion on the earth's surface, or in other words, the friction increased in the simple ratio of the velocity. On this supposition, the utility of increasing speed would appear extremely problematical, and in fact, nothing would seem to be gained but time, for which the loss of power, in many instances, would be deemed by no means an adequate compensation. The issue of this old doctrine is what I now attempt to establish; for, although "the retarding force of a body in motion" is not "in the simple ratio of the velocity," the power required is in that *ratio,—T. W. B.*

In the Magazine for August, the subject is continued, and I find the same idea in these words:—"Quite different from this (referring to horse power) is the nature of the steam engine; its power is not diminished in the least by any increase of speed in the motion of the engine, however great that increase may be, and the only limits which it meets with in its progress, is the resistance of the air, which, as we have already observed, prevents the infinite acceleration, and renders the motion uniform." The next two pages consist of strictures on two other writers, for overlooking, or considering too lightly the resistance of the air, in the attainment of infinite velocity on a railway. One of whom however admits, that it will "ultimately become uniform, owing to that resistance, although he too asserts that an addition of power too trifling to add any thing material to the weight of the vehicle, would raise the terminal or uniform velocity from 4 miles an hour to 20, and that *speaking practically, it would cost no more to command a velocity of 20 miles an hour on a rail-way, than a velocity of one.*"

Then continues the author:—"*Thus both* these writers have come to the conclusion, that the resistance, which a body meets from the atmosphere, is either none at all, or nearly as little, at the rate of 20 miles an hour, as at the rate of 4 miles." I have thus far dwelt on quotations, as necessary to justify the idea I have assumed, and read and re-read all the pieces to which I have alluded, with a view to discover whether I am not warranted in that idea viz:

That all the writers have supposed that a locomotive engine of sufficient power to overcome the friction, and give any motion at all to the carriage, can (admitting the friction to be uniform and no atmospheric resistance) continue to accelerate that motion. I will admit that a carriage on a railway, when in motion, requires no *greater* constantly propelling power, to maintain that motion, than would be equal to the friction when at rest.

A steam engine, loaded so that it cannot move, is of no power, and produces no more effect than the pig iron from which it was made. No *steam* is used, no *power* is used; (and these are synonimous terms here;) let the cylinder be of such capacity, that it exhibits a propelling pressure equal to 1000 lb. Relieve the carriage to be propelled, till this force is able to set it in motion; open the throttle valve so that the steam may have sufficient access to the cylinder, to keep up this pressure of 1000 lb. when making 10 strokes a minute; and (for sake of illustration) we will call it a "one horse power," which propels the carriage at the rate of 2 miles an hour; enlarge the opening, so that the pressure of 1000 lbs. shall be kept up, with the engine making 20 strokes a minute, and we have a "two horse power," taking us 4 miles an hour, and so on, till we make an hundred strokes a minute, when we have an engine of 10 horse power, and obtain a velocity of 20 miles per hour. But where is the *steam (or power)* to come from?

From the very same source, required for the augmentation of power to an engine, driving the machinery of a Grist mill, or a cotton spinning factory,—the consumption of steam,—and if the engine attached to either of the above objects, be able to move at all, or overcome the friction and resistance of the work to be done, its motion will continue to increase, by increasing the openings to the cylinder until it fly to pieces, or the boilers are exhausted of steam of the original pressure; a carriage on a railway is governed precisely by the same law. The end is increased in the exact ratio of the means used, or power consumed. Not so with a boat, the power of the engine here wouldsoon be met by the increasing resistance of the water were the openings to the cylinder ever so free. In the above position in regard to railways, I have not taken into view the resistance of the atmosphere, and although *it is something*, I must come under the censure of the communicant to your Magazine, for undervaluing it. The wind blowing but a moderate breeze will move with a velocity of 10 miles an hour, making according to the theory set forth, the small difference of 20 miles an hour in the gentleman's travelling, whether it be for or against him.

The idea may suggest itself to some of your readers, that by having spur wheels, by means of which, the wheels supporting the carriage may be thrown into higher gear than the engine, after it has attained the velocity of 20 miles an hour, that the motion will be preserved, and a saving of steam result.

It is scarcely necessary for me to say, that the carriage would, so soon as its momentum ceased to aid the enfeebled action of the engine, stop entirely.

For let the gearing be so proportioned, that 20 strokes of the engine is only required for a 100 revolutions of the wheels of the carriage, and in place of a propelling force of 1000 lbs. required to overcome the friction, we have only one fifth of 200 lbs. therefore the carriage must stop.

Thos. W. Bakewell

Cincinnati, State of Ohio, US.
America, 1st Feb. 1826.

ELECTRICITY.

When certain bodies, as glass, amber, sealing wax are rubbed with dry flannel they acquire the property of alternately attracting and repelling light bodies such as feathers, cork, &c.

This friction may be so conducted, by means of electrical machines, as to charge glass plates, or jars coated with tin foil, so that when the inside and outside coating are brought into contact, a violent noise and a spark of light appears; animals may be thrown into convulsions and killed by it as by thunder. These, and similar phenomena, are classed under the science of Electricity.

It is at present believed that these phenomena are produced by the agency of a peculiar fluid which has received the name of the *electric fluid*, and which is supposed to exist in all bodies.

1. The particles repel each other with a force decreasing inversely as the square of the distance.

2. They attract the particles of common matter with a force decreasing inversely as the square of the distance.

3. This fluid is dispersed through the pores of other bodies and moves through them with various degrees of facility. Through some bodies it moves with great difficulty or cannot move at all. Through others it moves without any visible obstruction. The first class of bodies are called *non-conductors*, or electrics, the second *conductors*.

4. Non-conductors are glass, resins, silk, hair, baked-wood, air, &c. Conductors are metals, charcoal, liquids.

5. The phænomena of electricity may be divided into two kinds: 1. Those that are occasioned by its attractions and repulsion. 2. Those that are occasioned by its passage from one body to another.

1. Attractions and repulsions of Electrical Bodies.

7. When bodies contain redundant electricity they are said to be *positively*, electrified, or *plus*; when they contain less than their natural quantity they are said to be *negatively* electrified, or *minus*.

8. Electrics are brought into a positive or negative state by friction. Glass by friction is rendered positively electric; but sealing wax and other resins become negatively electric.

9. When a body contains redundant fluid, the surplus is repelled till it is brought to its natural state. When it is deficient, on the contrary, it attracts fluid from the surrounding bodies. But this influx orefflux is prevented if the body be a non-conductor or if it be surrounded by non-conductors. In this last case the body is said to be insulated and the electricity possesses considerable permanence.

10. When a body B in its natural state is brought near a body A overcharged, the state of the fluid B is altered, being repelled from the side next A, and heaped up on the side farthest off. Hence the side of B next A is negatively electrified and the side farthest off positively; A of course attracts B. This new state is produced in B even though an electric intervene. Hence nothing is communicated from A to B.

11. When an insulated body B is brought near an electrified body A, a spark is observed between them, B, is electrified permanently and the electricity of A is diminished.

In this case a portion of fluid passes instantaneously from A to B and the violence of the phenomena depends upon the quantity that thus passes.

12. After a body has thus communicated electricity to another it constantly repels it. Because now both bodies are brought into the same state.

The phenomena of thunder are occasioned by the transference of electricity from one stratum of air to another.

13. When two conductors in their natural state are brought into contact, one of them becomes positive, the other negative, and this state is permanent.

Such is an outline of the theory of electricity as it is at present received. But the new discoveries in galvanism have opened a new field of inquiry which may perhaps modify our opinions somewhat. They have served as a link to connect chemistry and electricity together, and promise fair to enlarge our notions in both. As these phenomena are scarcely susceptible of abridgement, we shall reserve our observations on them for a future number, when we shall make it our business to collect and arrange them, and to bring them as far as possible under the banners of a theory.

ELECTRICAL PISTOL.

In the *Phil. Trans. for* 1779, *p.* 382.—Dr. Ingenharz precribes the following method of preparing an inflammable gas to be used with the electrical pistol. The first method was by mixing equal quantities of sulphuric acid and spirit of wine and applying heat to the vial containing the compound. A great quantity of white vapour is extricated, which passing up the inverted or pistol receiver filled with water, settled at the top, and depressed the water like other airs. This air soon becomes clear, the white fumes being absorbed by the water. It was easily lighted in an open cylindrical glass, and burnt almost as clear as a candle, the flame descending gradually lower and lower till it reached the bottom, $\frac{1}{14}$ or $\frac{1}{10}$ of this air, with the rest common air kindled by an electric spark, made a loud explosion and shattered the glass which contained it, when it did not find a ready outlet.

The weight of this air is to that of common air of the same bulk as 10 to 9, consequently it will remain in a vessel although its mouth be uppermost.

By considering that the vapour rising by heat from spirit of wine and sulphuric acid, when condensed, yields æther by the usual process of distillation; he very justly concluded that the same vapour would be produced by æther simply. In prosecution of this idea he dropped some drops of æther into a strong cylindrical glass, and endeavour to make it explode by passing an electric charge through it but to no purpose. He afterwards found the causes of his failure to be either that he employed too great a quantity of æther or that the air or vapours of the æther was not thoroughly incorporated with the other air; for a number of drops of æther, which would not produce an explosion when the air pistol was kept still, produced a very loud one when it was forcibly shaken. He found the following method the surest of succeeding. Dip a small glass tube $\frac{1}{12}$ of an inch in diameter, open at both ends into a phial containing æther till 2 or 3 drops of the liquid have entered it, then put the finger on the upper end to keep the liquor suspended. The end of the tube containing the æther was immediately thurst into a small cautchouc or elastic gum bottle, and the finger taken from the other end, that the æther might drop into the cautchouc bottle, after which its neck is to be immediately inverted into the orifice of the air pistol; then give the external part of it a gentle squeeze and withdraw it, upon which a bullet or a cork is to be thurst into the mouth of it, when ready for firing. This whole operation may be performed in 5 or 6 seconds.

This air is absorbed by water, takes fire only when in contact with atmospheric air. Is unfit for respiration in a concentrated state, but agreeable when diluted. It is heavier than inflammable airs obtained from metals, mud, marshes, &c. It does not inflame with so small an electric spark as other inflammable air.

TERTIARY; OR, ROCKS ABOVE CHACK; ALLUVIAL DEPOSITS, &c.

FROM MR. MILLER'S POPULAR PHILOSOPHY.

BUT what, you inquire, are those curious formations above *chalk*, which we see extending to a considerable distance round the capital of France,—upon which that city, indeed, may be said to rest, and of which we have as near a resemblance in the Isle of Wight, and in the strata immediately below our own metropolis? I am not surprised at these having attracted your attention, for this has been the case with many an eminent naturalist of late, and, independently of the several curious imbedded masses, and the wonderful diversity of petrifactions they contain, they may be said to be so many miniature models of nature, and the manner in which she arranges her different deposits when acting on a larger scale. The first of these is called the *Paris formation*, and consists of no less than nine distinctly marked strata, some of them containing a prodigious number of different species of shells, exclusive of the chalky pedestal upon which it rests, and the alluvial formation at the top. The others have been named by modern geologists the *Isle of Wight* and *London basins*, both of which also rests upon extensive concavities of chalk, and, like the former, are composed of a number of different and distinctly marked formations.*

These with the *Hertfordshire pudding-stone*, and what is called the *brown coal* formation, both of which lie also above chalk, may therefore be not inaptly designated, the *tertiary*, or, as Professor Jameson has it, the *newest floetz formation*.

Of the Hertfordshire *pudding-stone*, little need be said, as you observe it is so very limited in its extent; it is, however, much esteemed on account of its beautiful colours, and when cut and polished may be applied to the same purposes

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* From the following extract of a letter, dated New York, 13th April, 1825, it would appear, that these tertiary formations are not confined to what is denominated the old world.—"The tertiary formations, the existence of which I have so long advocated, and have been at so much trouble to ascertain and explain, form now one of our most interesting geological divisions, and are daily becoming more studied. Their characters are precisely similar to the analogous strata in the celebrated basins of the Isle of Wight and of Paris, so well described, respectively, by Webster and by Cuvier."—*Literary Gazette.*

We have not time to examine minutely the different strata of which these series of rocks are composed, but it may be observed of them in general, in the words of a modern writer, (Professor Jameson in his Illustrations of Cuvier's Essay,) that "they appear to have been deposited from the waters of lakes or inland seas, some of which are conjectured to have been alternately filled with fresh and salt water; and hence, in a general view, are of a more local nature than those which have been deposited from the waters of the ocean." The oldest or lowest of these formations, as well as some of these above them, contain petrifactions, but "the newest members of the series, are of so loose a texture, the fossil organic remains they contain so nearly resemble those that now inhabit the earth, and they are so nearly related to the alluvial formations which are daily forming, that it is often extremely difficult to determine whether they belong to the alluvial or newest floetz formation."

Thus we see that these curious formations, which have so recently attracted the particular attention of the geologist, may be considered as belonging to a series of rocks of still newer formation than any of those which have been so long considered as the only connecting or uniting links betwixt the primary and alluvial classes.

Iighland Breccia, or Plum-
; Rock.

such, however, is the case
he *brown coal* formation,
in some situations on the
it, is very extensively distri-
and is found in great abun-
i the extensive flat at Bovey
teter in England.*

ie composition of this sub-
we not only behold the min-
ts most perfect state, but we
the different appearances it
in its various stages, while
from wood into coal—from
ous and longitudinal texture
productions of the forest, to
e brittle and indurated state
plintery material of the mine.
whence you may ask, have
hose vast accumulations of
rom which these butiminous
s are formed, if this is the
It would require whole for-
constitute those immense
coal which we have passed
progress, and surely you do
an to say, that whole forests
en swallowed up and depos-
the bowels of the earth?
really do say so;—and it for-
y so happens, that, at the
moment, we need not go so
Lincolnshire and Lancashire,
for an extensive subterranean, and to the coast of the former for an immense sub-marine forest, in confirmation of my allegation;—Observe these men at work at yonder opening, which admits the light of day into these dark recesses, in the neighbourhood of the spot upon which the city of Carlisle is situated.—What have they been labouring at, and what the purport of these consultations?—What the cause of all those gazings and wonderings, and expressions of surprise, that have reached our ears, and drawn our attention to that particular spot, with so much around us on every side to engage our notice, and excite our admiration otherwise?—Why, these men, in course of their excavations, have fallen in with, and laid open a subterranean forest!—It is really the case! In clearing away the foundations of the ancient Roman wall, in order to form the bed of the canal, from the above mentioned city to the west sea, these labourers have fallen in with a subterraneous forest of oak, imbedded in a stiff blue clay, lying from two to three feet below the foundation of the Roman wall, which, no doubt, unknown to the builders, passed over it!*

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though as fuel the Bovey coal is only used by the poorer classes, it is deserv-
our particular attention, on account of some singularities that belong to it,
ich seem to mark it out as a very visible transition, or connecting link be-
ie mineral and vegetable kingdom. That the Bovey coal, or brown coal
on, to which it belongs, in its more perfectly mineralized state, is of the
f rocks we are now considering, there can be no doubt; but if there still
be any as to the *vegetable origin of coal*, here, in this formation, we have ocu-
onstration of the truth of a position, that is now almost universally believed;
the Bovey coal, we find Nature, as it were, busy at her work, and can dis-
trace and mark her progress, ere she has yet completed her task.

xtract from a periodical publication for March, 1824.—" At the anniversary
g of the Antiquarian society of Newcastle, last month, an interesting paper,
W. Chapman was read, giving an account of the antiquities and curiosities
red in digging the canal from Carlisle to the west sea. The most interesting
this communication related to the discovery, on the shores of the Solway
beyond Brough, of a subterraneous forest of oak, imbedded in a stiff blue
id lying from two or three feet below the foundation of the Roman wall, which
over it. The trees, which were of large dimensions, were all lying towards the

No wonder, indeed, at these expressions of surprise!—Goldsmith, in the beautiful and affecting manner in which he describes the changes that had taken place in society, had a most appropriate, and a very striking contrast in view, when he said:

> "As in those domes, where Cesars once bore sway,
> Defaced by time, and tottering in decay,
> Amidst the ruin, heedless of the dead,
> The shelter-seeking peasant builds his shed;"

But here has been a change still more complete than can possibly take place among the dwellings of
men!—here is a contrast fa
grand—far more sublimely st
—A Roman wall it appea
stood, firm and compact as a
of defence, not where once
but where still lay buried in
ion and forgetfulness, the
oaks, the kings of the fore
other times.

But it is not only in the
or brown coal formation, t
may detect this process of
from one material to another,
ing on in this division of the
laboratory of Nature!*—In al

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north; the stumps of some were in their natural position. And, what is r
markable, the wood of these trees was in so perfect a state, as to be scarcely
guishable from fresh oak, although it is evident, that it must have lain the
thousand years, as the period of its growth must have been anterior to the b
of the Roman Wall."

And the same publication for January, 1826, contains the following noti
Submarine Forest.—"The submarine forest, at the mouth of the Char, is abo
a mile in breadth; the sea prevents its being traced any farther in a southern
tion. About a quarter of a mile from its first appearance, the different k
fern remain very perfect, and nuts are found scattered about in a petrified sta

* In the numerous other alluvial deposits, which, in this stage of our pr
we observe scattered, and indenting the earth's surface to different depths, i
direction around us, we see materials undergoing a state of preparation fo
purposes, some of them, no doubt, to be employed in the consolidation
stances, that will bear some analogy, or have some resemblance to, those ve
mations that we have just been considering.

In these beds of *peats* and of *turf*, with which so many of our mounta
moorish tracts abound, we can almost trace the change in all its shades and
of gradation, from the soft and heathery tuft at the top, to the almost mine
bituminous substance at the bottom; which, in its turn, as well as that, whi
had its origin from those subterranean and submarine relics of the once to
but now prostrate lords of the forest, may also, in its day, afford fuel of a mo
fectly mineralized kind, than that which it now presents in its present st
transformation.

In those *beds* of *shells* which we now see decomposing into pit of marl,—i
slimy and *calcareous* deposits, that cover the fields after floods, and the pl
the sides of rivers after inundations,—and in the *incrustations* that we behold
ing from the roof of caverns and of grottos,—may we not trace in embryo, t
mation of those future beds of limestone, and gypsum, of marble, and ala
that may serve the purposes of the artists of after generations,—and in those
erous deposits of *white* and *brown*, and *black* and *blue clays*; and in the vast
of subterranean *earths* and *loams*, and beds of *sand* and of *mud*, which are e
ed in their composition, as well as these *pebbly* and *gravelly* deposits, that
often to be met with at considerable depths beneath the surface, do we not p
the rudiments forming of other extensive layers of grey-wackes of slates, and
sandstones, and conglomerates of future times,—and in those accumulati
marshy ores, that are observed at the bottom of lakes, and in the *salt* which
lecting in the steppes of Siberia,—may we not discover, what may, at som
period, arrive at prodigious layers or beds of ironstone,—and form the basis o
masses of rock salt?

formations, which we now see accumulating under cover, or to speak more agreeably to the similitude I have adopted, that we now perceive coming forward in the sheds or outhouses of this our earthly habitation, we behold the *great Creator*, the *Supreme* and *Almighty architect of the universe*, who "*fainteth not, neither is weary*," preparing and bringing forward to maturity, an abundance of the most choice and well-selected materials for repairing and renovating of this mighty fabric to be made use of, and applied, as *his benevolence* may suggest, and *his wisdom* see necessary, in all time coming,—while, more immediately, under our eyes, we see also upon the surface, other matters heaping up from the disintegration of the substances of former creation, that will also, in their turn, become useful.*

The process of disintegration, which has already commenced on those enormous *blocks* and *boulders* of different materials, which have come from, *nobody knows where*, and have, by their appearance in those precise spots where they now lie, occasioned so much speculation among naturalists, may be accounted as the beginning of a new order of formations, as well as the scanty pittance of decomposed granite, which we observe just beginning to gather into a little adhering dust, on the summits of some of our highest mountain peaks,—and in these, we may behold, more specimens of the slender, and apparently insignificant, means, by which, the Great Author of Nature can accomplish the purposes of his will, and bring to pass the most complicated, and in their effect, the greatest ends.—Yes: in these few particles of mouldering dust, which viewed unphilosophically, might be considered as the commencement of that system of waste and decay, which, were there no repairing and renovating powers in Nature, might be expected to end in the ruin and destruction of the present order of things,—assisted by the light which science imparts, we can trace, in conjunction with the substances to which it gives rise, the origin of that truly valuable, and most abundantly diffused *alluvial deposit*, known by the name of

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* The *fine floating sands* of the African and Arabian deserts, which are at present carrying on such a war of devastation, against the once populous, but now desolated tracts beyond the Mediterranean, will perhaps, ere long, be arrested in their destructive career, by some consilidating substance and made to assume a more solid and less destructive form, in the shape of mountains of quartz; while the *light sprinkling of salt*, that now sparkles on the surface, or mixes with the soil, of some of those arid regions, may be made to assume the form of a saline deposit, or to mix with the waters, of some intervening seas or lakes.

Those beautiful accumulations of *broken corals*, and minute *particles of shells*, that form our walks by the side of the sea-shore, already afford among them, specimens of what they may one day become, in masses of greater hardness and tenacity.

And the numerous *downs* that line our coast,—and those extensive ranges of *sand hills* that skirt the body of the ocean,—and those finely pulverised beds of *gravel*, intermixed, as they are, with that beautiful assemblage of *flints* and of *pebbles*, for which our part of the coast has been so long celebrated; and which, in other situations, at the bottom of streams and of rivulets, are found mixed with *gems* of the most precious kind, and *ores* and *grains* of the most valuable metals,—may, at some future period, appear in some other forms, which may afterwards, by the separation of their parts, give rise to other boulders and conglomerates, than those which we now behold, scattered about and towering above the lesser fragments on our shores, or left, in isolated and solitary blocks upon our plains.

vegetable mould, which, at once, fertilizes, beautifies, and enriches creation; which, in the words of Pliny, "Like a kind mother receives us at our birth, and sustains us when born;"* and, in those of Goldsmith, that, "Gentle and indulgent, ever subservient to the wants of man, spreads his walks with flowers, and his table with plenty; returns with interest every good committed to her care; and though she produces the poison, she still supplies the antidote. Though constantly teazed, more to furnish the luxuries of man than his necessities,, yet, even to the last, she continues her kind indulgence, and when life is over, she piously covers his remains in her bosom."

The economy of Nature, in the truly wonderful, but simple process, adopted in the formation of soils, is extremely curious, but is most beautifully and satisfactorily delineated, by the distinguished individual, who at present fills the chair of the Royal Society at London, Sir Humphry Davy, in his Agricultural Chemistry;† who afterwards

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* Pliny's Natural History, Book ii. chap. 63.

† "Soils," say Sir Humphry, "appear to have been originally produced, in consequence of the decomposition of rocks and strata. It often happens that soils are found, in an unaltered state, upon the rocks from whence they are derived. It is easy to form an idea of the manner in which rocks were converted into soils, by referring to the instance of *soft granite*, or *porcelain granite*.

"This substance consists of three ingredients, quartz, feldspar, and mica. The quartz, is almost pure silicious earth, in a crystalline form. The feldspar and mica, are very compounded substances; both contain silica, alumina, and oxide of iron;—in the feldspar there is usually lime and potassa; in the mica, lime and magnesia.

"When a granitic rock of this kind, has been long exposed to the influence of air and water, the lime and potassa, contained in its constituent parts, are acted upon by water, or carbonic acid; and the oxide of iron, which is always in its least oxided state, tends to combine with more oxygen; the consequence is, that the feldspar decomposes in it, and likewise the mica, but the first the most rapidly. The feldspar, which is, as it were, the cement of the stone, forms a fine clay: the mica partially decomposed mixes with as sand; and the undecomposed quartz appears as gravel, or sand of different degrees of fineness.

"As soon as the smallest layer of earth is formed on the surface of a rock, the seeds of the lichens, mosses, and other imperfect vegetables, which are constantly floating in the atmosphere, and which, have made it their resting place, begin to vegetate; their death, decomposition, and decay, afford a certain quantity of organizable matter, which mixes with the earthy particles of the rock; in this improved soil, more perfect plants are capable of subsisting; these, in their turn, absorb nourishment from water and the atmosphere; and, after perishing, afford new materials to those already provided:—the decomposition of the rock still continues; and at length, by such slow and gradual processes, a soil is formed, in which even forest trees can fix their roots, and which is fitted to reward the labours of the cultivator."—*See Davy's Agricultural Chemistry*, pages 174, 175. Edit. 1821.

(To be Continued.)

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> " There may be some merit without elevation, but there is no elevation without merit."—*Rochefoucauld.*

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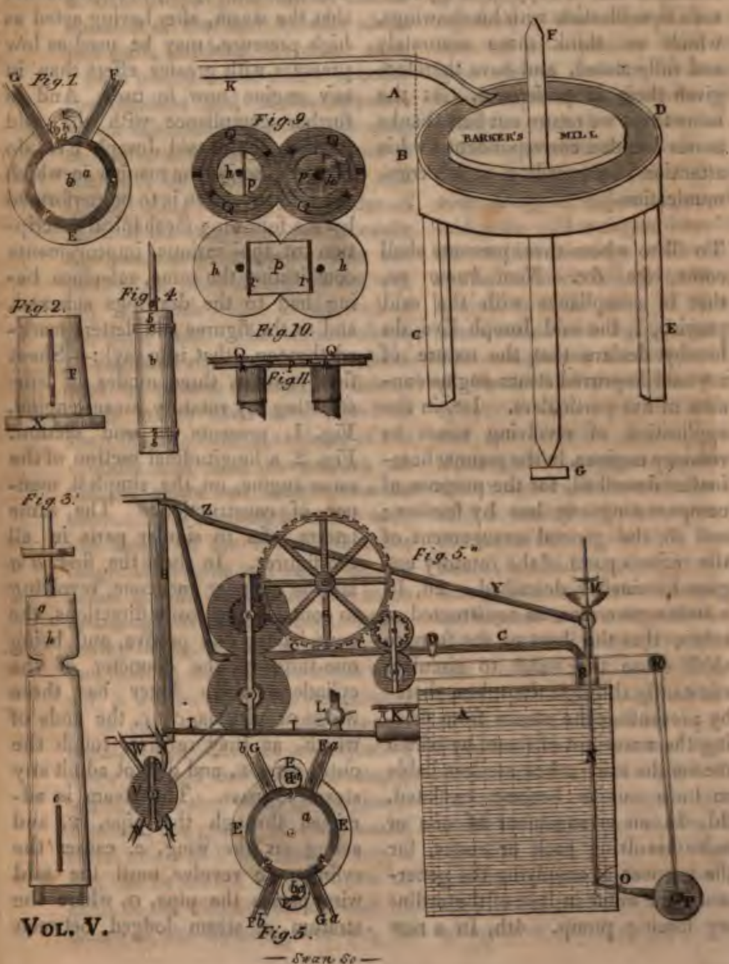
MR. EVE'S IMPROVED STEAM ENGINE.



— *Swan Sc* —

SPECIFICATION OF THE PATENT GRANTED TO JOSEPH EVE, LATE OF AUGUSTA GEORGIA, IN THE UNITED STATES OF AMERICA, BUT NOW RESIDING AT LIVERPOOL, IN THE COUNTY OF LANCASTER, ENGINEER, FOR AN IMPROVED STEAM-ENGINE. DATED NOVEMBER 24, 1825.

[Our London Correspondent has transmitted us an account of Mr. Eve's improvement on the Steam Engine, which we promised to give in one of our former numbers, but we have, at the same time, been favoured with a copy of the patentee's Specification with his drawings, which we think more accurately and fully stated, and have therefore given them in preference. At the same time, we return our best thanks to our London correspondent for his attention in forwarding us his communication.]

To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Joseph Eve, do hereby declare that the nature of my said improved steam-engine consists of five particulars. 1st, in the application of revolving cones to rotatory engines, in the manner hereinafter described, for the purpose of compensating any loss by friction; and in the general arrangement of the various parts of the rotatory engine hereinafter described. 2d, In a steam-generator, so constructed of tubes, that the heat of the furnace shall cause the water to circulate constantly through the tubes, thereby preventing the steam from driving the water out of them, by which means the said tubes are less liable to burn out or become oxidated. 3d, In an arrangement of one or more revolving cock or cocks, for the purpose of supplying the generator with water in lieu of the ordinary forcing pump. 4th, In a new safety apparatus, by which the elasticity of steam in boilers is ascertained by weight directly applied instead of indirectly, as in the ordinary steel-yard valve. And 5th, In such an arrangement of cog wheels with a compound engine, in such manner that the steam, after having acted as high pressure, may be used as low pressure with greater effect than in any engine now in use. And in further compliance with the said proviso, I, the said Joseph Eve, do hereby describe the manner in which my said invention is to be performed by the following mechanical description of the various improvements constituting the same, reference being had to the drawings annexed, and to the figures and letters marked thereon, (that is to say):—Sheet first contains three modes of constructing my rotatory steam-engine. Fig. 1, presents an end section. Fig. 2, a longitudinal section of the same engine, on the simplest manner of construction. The same letters refer to similar parts in all the figures. In sheet the first, *a a* are the cylinder and cone, revolving in contact in opposite directions, the cone having one groove, and being one-third of the diameter of the cylinder, which latter has three wings or pistons, *c c c*, the ends of which, as they revolve, touch the outer case, E, and do not admit any steam to pass. The steam is admitted through the pipe, F, and acting on the wing, *c*, causes the cylinder to revolve until the said wing passes the pipe, G, where the stratum of steam lodged between each two wings is allowed to escape; the wing which has thus passed falls into the groove *d*, of the cone, the bottom of which groove it touches in passing, thus allowing no steam to escape between. The said wing, *c*, then passes again by the steam pipe, F, and is acted upon as before described, and so on in rotation. The cylinder, *a*, which is firmly fixed to its axis, *b*, rests on one side, on the outer case, E, through which the axis projects; but as there is some friction produced by the revolution of the said cylinder at its two ends, touching the outer case, I have placed a false end, *h h*, under the opposite end of the cylinder, which false end slides on the axis, *a*, freely, and has a thread out at the end, by means of which, and the adjusting nut, *i*, the cylinder, if worn at the two ends, can be easily tightened and adjusted. The adjusting nut is confined by the collar, K, which collar is screwed to the outer case. The conical shape of the small runner, which can likewise be moved upwards or downwards in the outer case, serves to keep the two convex surfaces of the cylinder and cone in contact, so that no steam can escape between them. It is obvious, from the conical shape of the runner, that the longer the engine will be in use the better it will work, and the more steam-tight it will become. By referring to fig. 3, which presents a longitudinal view of the conical runner, it will be seen that the groove, *d*, is cut into a separate piece of metal, which slides by an adjusting screw up and down in the empty space, X, so that when the engine is adjusted, the groove or the piece of metal into which the said groove is cut, can be moved up and down so as to fit the wings of the cylinder by means of the adjusting screw, *o*, as exhibited in this and in fig. 4, which latter figure presents an end view of the before described cone. The dotted lines in the said fig. 4 shew the appearance of the sliding piece containing the groove. Letters *n n*, in fig. 11, present two cog wheels, running into each other, attached on the outside of the engine to the axis of the cylinder and cone, placed there for the purpose of producing a corresponding revolution of the said cylinder and cone, causing the groove of the cone to present itself regularly to the wings of the cylinder. *o* is a pinion, fixed to the other end of the axis by means of which any machinery can be put into motion. Another variety of constituting a steam-engine on my principle is shewn by an end section view in fig. 5, and an external view in fig. 6. This engine has a cylinder with three rings and two small conical runners on each side; said conical runners being of the same construction as in fig. 3, represented with one groove cut into each, and of one-third of the diameter of the cylinder. There are two induction and two eduction steam pipes, and although the engine may be, with the exception of the addition of one of the conical runners, exactly of the same size as the one first described, a double quantity of steam is requisite, and twice the power of the former engine is gained. The steam enters through pipe F, *a*, and acts on the wing, *c*, which, after having passed pipe G, *a*, where the steam escapes, falls into the groove, *d*, of the lower cone, and appearing at the induction steam-pipe, F, *b*, is loaded again with steam pressure, which it discharges at the second eduction pipe, G, *b*, and then enters the groove of the upper cone; after having passed which, it is loaded again at the first mentioned induction pipe. Letters *m m m*, in fig. 6, are bridges by which the spindles, *b b b*, of the cylinders and cones are supported. I have represented six bridges in the drawing, but two bridges on each end, and supporting the three spindles or axis, will answer as well, or any other contrivance to support them properly. This engine has three cog wheels, *n n n*, attached to the three spindles so as to cause the cylinder and cones to revolve in unison, and like the first described engine, a pinion, *o*, on the opposite end of the axis of the cylinder. Fig. 7 shews an end section view, and fig. 8, a longitudinal section. Figs. 12 and 13 two external views of an engine which I have constructed upon a different plan, without altering any of the leading principles of the two engines heretofore described. The same letters already explained apply likewise to the last mentioned figures. The two conical runners in this engine are of an equal length and diameter; each has two wings or pistons attached, and two grooves cut into it, and in revolving in opposite directions, the wing of one runner falls alternately into the groove of the other. The steam enters by pipe F, and as the cylinders are running in contact it cannot escape between them, but acts upon the two wings in an opposite direction, and escapes at the eduction pipe, G, after the said wings have passed the same. By reference to fig. 8, which represents the longitudinal section, it will be seen that the two cones have each two false ends, *h h h*, sliding freely on their spindles; the two outer cases, E E, fit over the runners and their wings exactly. Each of the four false ends has an adjusting nut, by which the engine is tightened if steam escape, or slackened if it run too tight. Each pair of the false ends, where they join, have a plate that connects them and breaks their joint so as to prevent escape of steam. This plate, *p*, slides into the groove, *r*, cut out of the false ends, as exhibited by figs. 10 and 11, the former shewing an end view of the false ends, with the connecting plate in the middle; the latter, figure 11, exhibiting a longitudinal view of the said false ends or bottoms. On these false ends packing rings, Q Q Q, which are confined to the sliding plate, as exhibited in fig. 9, are placed; these rings press against the hollow outer case, and prevent any steam escaping by them. These packing rings are shewn in section, in fig. 8. It will be evident that the false ends need not be made true if the connecting plates and packing rings, as above described, are adopted; and that the engine, if provided with moveable false ends, conical runners, and the afore-described connecting plates and packing rings attached, or shewn in fig. 8, can always be kept steam-tight; and by use, the various parts on which there is any friction will fit better.

HINTS RESPECTING THE THEORY OF BLEACHING,

BY JAMES RENNIE, A. M. LECTURER ON PHILOSOPHY, &c. &c. LONDON.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

SECTION VI.

WHEN I entered upon my inquiries into the Art of Bleaching, I anticipated that I would find the theoretical discussions connected with it, very instructive, and opening a wild field for philosophical research. In the first of these anticipations I have been greatly disappointed; the second has much embarrassed me; for the field of research is so extensive, and withal so impenetrable by the ordinary paths of philosophy, that I have been discouraged from attempting what Newton and Herschel, and Berthollet and Davy, have failed to accomplish. When it is recollected that it embraces the very difficult subject of colour and coloured light, as well as the most abstruse doctrines of Chemistry, this will appear no way surprising. I shall, therefore, be obliged to relinquish the thought of giving a connected theory of the art, and must content myself with the few imperfect hints which have come to my knowledge. I have even left myself but little room for these, as the essay has already swelled beyond the bounds which I had prescribed to myself at its commencement. The imperfection of the theory however is of little moment in the practice of the art, and if the chemical bleacher can explain the proximate operations of affinity in destroying colour, he need give himself very little trouble about the ultimate causes of coloured light and its decomposition.

Newton, having been able by means of a glass to de-compose from a ray of white light into 7 different colours, came to the conclusion, that light is made up of those colours proportionably blended, and that bodies derive their colours from their capability of absorbing or reflecting rays which are differently coloured. A cowslip, for example, reflects the yellow rays of the compound light, and absorbs all the others. It strikes *me that some very curious consequences may be* deduced from this theory. It evidently proceeds upon the supposition that light is material and can be mechanically divided, which is assuming what will not be granted without proof; but allowing the assumption, how comes it that the flower leaves of the cowslip do not increase in bulk from the absorption of a continued stream of light? And ought not this effect to be very apparent in the dark petals of the night-shade which, by the hypothesis, reflect almost none of the light that falls upon them? If it be said that plants have a particular set of organs which decompose this absorbed light, and convert it into nourishment, how will this apply to inorganic matter, coloured wafers for example, and coloured paper, which are not found to increase from this supposed absorption of light? Besides, why if the same kind of rays in every circumstance is precisely similar, should some be always reflected and others transmitted? This seems, on this hypothesis, wholly inexplicable. Later philosophers, among whom is M. Prieur, reduce the number of primitive colours to three, namely, red, green, and violet; the intermixture of red and green giving rise to orange or yellow, according as the one or other predominates in the composition, and so of the others. It is certain that by a particular mode of management, he produced white light by an intermixture of red, green, and blue rags. Delaval, in an experimental inquiry into the cause of the changes of colour, which is more laboured them philosophical, goes deeper, as he thinks, into the subject than Newton, and tells us that the result of his experiment was, that transmitted light is the cause of colour,—for all bodies being, as he says, naturally white, it is only by means of a thin transparent pellicle which covers them, and transmits the light, that they appear of different colours: according as the pellicle is thick or thin. Scrape, says he, a dyed feather, and you will find it white below this pellicle. Again, when the colouring matter of plants is extracted from them, the solid fibrous parts, thus divested of their covering, display that whiteness which is their peculiar characteristic. White paper and linen are formed of such fibrous vegetable matter, which is bleached by dissolving and detaching the heterogeneous coloured particles. It also appears, he thinks, that the earth which forms the solid substance of plants is white; that it is separable from the colouring matter by several means; that whenever it is either pure and unmixed, or diffused through transparent colourless media, it exhibits its whiteness, and is the only vegetable matter which is endued with a reflective power; that the colours of vegetables are produced by the light *reflected* from this white matter, and transmitted thence through the coloured vat or covering which is formed on its surface by the colouring particles, and that whenever the colouring matter is either discharged or divided by solution into particles, too *minute to exhibit any colour*, the solid earthy substance is exposed and shows its native whiteness. But this is assuredly a mere vision, and as unworthy of refutation as the mechanical theory of chemical combination and decomposition. Delaval's mode of experimenting was such as might prove any hypothesis, however absurd, for he seems not to have made his experiments, and thence drawn conclusions, but to have laid down a hypothesis with which he was previously determined *that his experiments* should agree. *This becomes* much more striking *from the beautiful* and luminous experiments of Dr. Herschell, by which he proves satisfactorily that colour does not at all depend upon the size of the particles of matter, nor on the thickness or thinness of pellicles, (*Phil. Mag.* xxx. 206.) Another hypothesis is, that light is a fluid, and the effect of the prism is to produce a chemical rather than a mechanical decomposition; and if this were sufficiently developed, I think it is more than probable that it would afford the most rational theory which has yet been proposed.

It will here suit our purpose better, to consider light as composed of three different sorts of rays, calorific, colorific, and de-oxidizing. The latter of these seem to act chiefly in decomposing bodies subjected to their influence, and are denominated de-oxidizing from their commonly disengaging oxygen from its combinations. When nitric acid, for example, which is destitute of colour, is exposed to the rays of the sun, oxygen gas is partially disengaged in fumes, and the acid becomes reddish. A similar effect is produced on the oxides of several of the metals, particularly the oxide of silver and gold, which are thus partially deprived of oxygen, and approach the metallic state. When paper, moistened with nitrate of silver, is thus exposed to the light, it immediately becomes black, and muriate of silver is similarly and even more speedily affected. It appears then that light produces changes in colour more by the disengaging of oxygen than by any mechanical reflection or transmission of its rays or particles. It will follow that oxygen is a principle much concerned in the original production of colour. This is confirmed by several facts which I have been at some pains to collect. When too much oxide has been employed for purifying flint glass so as to occasion purple colour in the plates, it is usual to thrust a piece of wood into the mass of melted metal, which quickly abstracts the colour. The oxide seems to impart its colour to the glass only when it is in a high state of oxidizement: the wood therefore becoming carbonized, abstracts a part of the oxygen, and the *colour of the glass disappears*, (*Park's Ess. on Glass*, Note v. 203.) That oxygen is the colouring principle seems probable also from this, that the woollen dyers cut their log-wood into chips sprinkling it abundantly with water, and in this moistened state, throwing it into great heaps, where it lies till the chips become heated or fermented. After lying a few months in this state, they give out their colouring matter in the dying copper much more easily, and in more abundance. This may be accounted for, by supposing that the water becomes in part decomposed, and that the oxygen uniting with the colouring matter renders it more intense, similar to the case of fluids, which deepen in colour as they ripen, by their gradual absorption of oxygen, (*see Ann. de Chim.* vi. 80.) When salts become coloured by accident, the manufacturing chemist employs charcoal to purify and clear them. He dissolves the salts, boils the solution on charcoal, and when recrystalized, they are found to be pure and colourless. (*Parke's Ess. on Carbon.* ii. 311.) Now does not this, I would ask, arise from the property which charcoal has of absorbing all the known gases and condensing them within its pores in quantities, far exceeding its own bulk? (*See Journ. de Phys. An.* 12,) where Morozzo proves this by a series of experiments. *And does it not* appear plain that the charcoal, in the case in question, absorbs the oxygen gas, and so effects the destruction of the colouring matter of the salts? The phenomena exhibited by sympathetic inks seem all to countenance this idea. That prepared with muriate of cobalt, for example, which appears and disappears according to the presence or absence of a certain quantity of caloric. When the muriate of cobalt is pure, it produces with caloric a beautiful blue; when mixed with iron, the blue becomes green. Now, in this case, seems it not probable that the caloric facilitates its combination with the oxygen of the atmosphere with the metal? or is it the caloric itself which is the colouring principle? Theward found that when a piece of purified Phosphorous of a pale yellow colour was melted in *hot* water, and then plunged into *cold* water, it became perfectly black, and always recovered its original colour upon being re-melted. Biot confirmed this, and attempted to show that colour depends on the mechanical condition of the component particle of bodies. A fact analogous to that stated by Theward, was observed by Dr. Brewster in preparing prisms of realgar by melting it between glass plates. This substance is naturally dark orange red, but it became darker as the heat was increased, till at a certain temperature it became quite black. When cold it recovered its original red colour. Mr. Brandes states that when nitrous acid gas is exposed to heat, its orange colour becomes more intense, so as to appear nearly black. (*Journ of Sc. and Art.* i. p. 200.) M. Hermstads concludes from a series of well conducted experiments on the colouring principles of Achiveal (Phil. Mag. xiv. 319.) that many of the metals and earths possess a certain chemical affinity for this principle, and that the *acid*, which serves as a solvent for these substances, exercises a great influence on the shades produced. Oxygen also he found to affect considerably the production of scarlet by the muriate of tin when oxidated by the air. The same doctrine seems to be farther confirmed by the very interesting and curious experiments of Sir Francis Ford, (*Phil. Mag.* i. 100.) who found when oxygen was diffused through water, and sprinkled on flowers, that they assumed more brilliant colours, and even in some cases, had those colours considerably changed. It has also been thought by some of the ablest chemists of the age, that oxygen is the agent which affects the colour of the blood. Those facts might easily be multiplied to infinity. I shall hold these to be sufficient. *See Bancroft*, p. 15.

But granting it proved that oxygen is one of the chief principles which produce colour, we are still totally in the dark, as to the manner in which it acts, in the case in question. Does it decompose the rays of light? or does it modify their action on the organs of vision? If it does so, why does it not always produce the same effect, or in other words, the same colour? If light be a fluid composed of different particles, is it by atoms of oxygen combining with these in definite proportions that the phenomena of colours are produced. If so, how many atoms of oxygen in combination constitute, for example, a green colour?

TERTIARY; OR, ROCKS ABOVE CHALK; ALLUVIAL DEPOSITS, &c.

From Mr. Millar's Popular Philosophy.

(Continued from Page 386.)

Goes on, in the same excellent treatise, to account for that variety and and difference so perceptible in the composition of soils so formed;* and then proceeds to point out what he considers the most proper method to be adopted for the amelioration and improvement of such as stand in need; and does not rest satisfied, until he acatully directs his readers to the particular spots, where the materials most suitable for the purpose are, in general, to be easily come at.*

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* "Poor and hungry soils," says he, "such as are produced from the decomposition of granitic and sandstone rocks, remain very often for ages with only a thin covering of vegetation. Soils, from the decomposition of limestone, chalks, and and basalts, are often clothed by nature with the perennial grasses; and afford, when ploughed up, a rich bed of vegetation, for every species of cultivated plant.

"It is evident, from what has been said concerning the production of soils from rocks, that there must be at least as many varieties of soils, as there are species of rocks exposed at the surface of the earth; in fact, there are many more. Independant of the changes produced by cultivation, and the exertions of human labour, the materials of strata have been mixed together, and transported from place to place, by various great alterations that have taken place in the system of our globe, and by the constant operation of water. In general, the soils, the materials of which are the most various and heterogeneous, are those called alluvial, or which have been formed from the depositions of rivers: many of them are extremely fertile." *Ibid* 177, 184, 185.

It is by means, such as are described by this intelligent and able writer, that the fine coat of vegetable mould is formed, which, in midst of the changes that are continually taking place in the materials of this our world, gives rise to so many different shapes and forms, and serves as a store-house, whence the animal and vegetable kingdom are renewed,—not only providing sufficient sustenance for man and beast, but yielding support and nutriment to the vegetable tribes;—where the trees of the forest spread their wide extended roots, and the tender herbs, and the flower of the field, take hold of the dust. It may be added, where, many of the orders of animated beings find a place of habitation,—where the pliant worm drags itself forward with ease and adroitness—the mole explores his darksome way—the foxes have holes—and the conies form their subterranean burrows.

Nor, are the other alluvial formations to be supposed destitute of their immediate uses,—and to be considered as lying in a state of uselessness, so far as respects the present generation, while they are undergoing changes, and in a state of preparation for the wants of another.*

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* "In ascertaining the composition of sterile soils with a view to their improvement, any particular ingredient which is the cause of their unproductiveness, should be particularly attended to; if possible, they should be compared with fertle soils in the same neighbourhood, and in similar situations, as the difference of the composition may, in many cases, indicate the most proper methods of improvement. If, on washing a sterile soil, it is found to contain the salt of iron, or any acid matter, it may be ameliorated by the application of quick-lime. A soil of good apparent texture from Lincolnshire, was put into my hands, by Sir Joseph Banks, as remarkable for sterility. On examining it I found that it contained sulphate of iron; and I offered the obvious remedy of top-dressing with lime, which converts the sulphate into a manure. If there be an excess of calcareous matter in the soil, it may be improved by the application of sand or clay. Soils too abundant in sand, are benefited by the use of clay or marl, or vegetable matter. A field belonging to Sir Robert Vaugham at Nannau, Merionethshire, the soil of which was a light sand, was much burnt up in the summer of 1805; I recommended to that gentleman the application of peat as a top dressing. The experiment was attended with immediate good effects; and Sir Robert, last year, informed me, that the benefit was permanent. A deficiency of vegetable or animal matter must be supplied by manure. An excess of vegetable matter is to be removed by burning, or to be remedied by the application of earthy materials. The improvement of peats, or bogs, or marsh lands, must be preceded by draining; stagnant water being injurious to all the nutritive classes of plants. Soft black peats, when drained, are often made productive, by the mere application of sand or clay as a top-dressing. When peats are acid, or contain ferruginous salts, calcareous matter is absolutely necessary in bringing them into cultivation. When they abound in the branches and roots of trees or when their surface entirely consists of living vegetables, the wood or the vegetables, must either be carried off, or be destroyed by burning. In the last case, their ashes afford earthy ingredients, fitted to improve the texture of the peat.

"The best natural soils, are those of which the materials have been derived from different strata; which have been minutely divided by air and water, and are intimately blended together: and, in improving soils artificially, the farmer cannot do better than imitate the processes of nature."

"The materials necessary for the purpose, are seldom far distant; coarse sand is often found immediately on chalk; and beds of sand and gravel are common below clay. The labour of improving the texture or consitution of the soil, is repaid by a great permanent advantage; less manure is required, and its fertility insured. And capital *laid out in this* way, secures for ever the productiveness, and *consequently the value of the land.*"—Ibid 187, 188, and 189.

Amongst the substances usually met with on the sea-coast, and which go under the name of pebbles and gravel, Mr. Mawe enumerates *flints* and *chalcedonies*, *agates* and *jaspers*,—and as occuring less fre-

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* No: the inhabitants of those places which are situated in the neighbourhood of subterranean forests, and of coal imperfectly formed, do not wait till Nature has completed her mineralizing process to make use of them as *fuel*,—and the utility of *peat* and *turf*, in the absence of coal, in our moorish and hilly districts, are well known. The use of *marl*, as an article of manure, seems now to be pretty well understood; and no person can be ignorant of the happy effects of *slimy* deposits, who have seen or read of the fertilizing properties of those substances that are left on the banks of the Nile and other African rivers;—and the *calcareous incrustations* in the inside of caverns and of grottos, we shall afterwards have occasion to speak of.

The uses of the different sorts of *clay*, are too numerous for description:—Are we in want of stones for building? *Clay*, by undergoing the process of burning, in the form of bricks, becomes firm and hard to withstand the most rigid blasts of winter. Are there no slate quarries in the neighbourhood?—clay, in the shape of tiles, forms an excellent substitute. Are we in want of lead for pipes to convey our water from a distance?—clay comes seasonably to our aid; in short, by this mean-looking, dirty, and despised substance, called common clay, we are abundantly supplied with a great variety of utensils and vessels, neat in their structure, cleanly in the use, and, though cheap in the purchase, extremely valuable in point of utility,—while pipe-clay, a species or variety of this tenacious article, furnishes us with an abundance of tobacco pipes, and is likewise used in the manufacture of Queen's ware pottery,—and Tripoli, another variety, has been found useful in the polishing of metal and of stones,—clay is, besides, of the greatest utility for forming the bottom of ponds, reservoirs and canals, and rendering them what is called water-tight. I need scarcely add, that it forms, in general, one of the constituent parts in the composition of that useful earth called arable, which we have already considered under the appellation of vegetable mould, and which returns with such productive interest the seed committed to its extensive layers. As an article of manure, too, for the melioration or improvement of other soils, *clay-ashes* are highly recommended by modern practice; and where coal cannot be obtained at a reasonable rate, *turf*, with a small portion of wood, would answer every purpose to burn the clay, with a small addition of manual labour.

Those vast accumulations of *pebbles* and *gravel*, and the coarser kinds of *sand*, which are found at considerable depths in the earth, and, it may be, those capacious beds of *sea-sand*, that line the bottom of the ocean, may serve as so many vast filtering machines in the great store-house of Nature, and many other important purposes which we have not as yet thought of,—while, in situations distant from the banks of the ocean, they may furnish materials for our dry and pleasant walks.

In the districts of Scandinavia, in which *bog iron-ore* abounds, it is found of a very rich quality, capable of affording good iron,—and so rapid is the renewal of this valuable deposit at the bottom of the lakes in that country, that it is dredged out, in some instances, every ten years,—although in others, not quite so often,—and the quantities of *salt* that incrust the surface of the great salt desert in Persia, and abound so much in a state of efflorescence,—as well as in the ponds and salt-lakes of Siberia,—afford to the natives a supply sufficient to constitute an article of commerce.

The uses of *sea-sand*, in the composition of mortar and the coarser kinds of glass, as well as an article of manure in clay soils, and as a principal ingredient in the construction of our filtering machines, are well known,—and these collections of *sand hills*, which in numberless instances line our coasts, and form our extensive links and downs, will be found to serve other purposes, than merely as places for *the rabbits*, which have taken up their abode among them, to burrow in.

"When the sea-coast is low," Cuvier observes, "and the bottom consists of sand, the waves push this sand towards the shore, where, at every reflux of the tide, quently, although by no means uncommon, rounded pieces of *granite*, *greenstone*, and *porphyry*:—*Limestone*, *slate*, *sandstone*, and other less hardened substances, more rarely occur; or, if they do, they must be of temporary duration, as, among the pebbles of a surf-beaten coast, such materials are not of sufficient hardness to resist long the action of attrition, and, consequently, are seen broken down into sand and dust.*

It is not, however, only, in these slow and silent, though on those accounts, no less sure, processes of Nature, some of which I have been

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t becomes partially dried; and the winds, which almost always blow from the sea, drift up some portion of it upon the beach. By this means *downs*, or ranges of low sand-hills, are formed along the coast.

"These, if not fixed by the growth of suitable plants, either disseminated by Nature, or propagated by human industry, would be gradually, but certainly, carried towards the interior, covering up the fertile plains with their sterile particles, and rendering them unfit for the habitation of mankind; because, the same winds which carry the loose dry sand from the shore to form the downs, would necessarily continue to drift that which is at the summit farther towards the land."* But in the construction of these sand-hills, Nature, or rather the God of Nature, kindly interposes without the aid of man, and fixes and cements, not only their basis, but the whole superstructure up to the very top, by the growth of wild liquorice, and other suitable binding plants, so that they become (instead of recepticles of so many sand-floods, awaiting the propelling powers of the winds, in order to deluge in sterility the neighbouring tracts,) *mounds* to prevent the farther encroachments of the sea—the most effectual barriers against the overflowings of the ocean!—*See Cuvier's Essay on the Theory of the Earth*, p. 29. Ed. 1822.

* Considered separately, I shall say nothing of the uses to which these indurated substances, which constitute such vast accumulations of pebbles and gravel, as are usually met with upon the sea-coast, are formed in this place,—but, taken collectively, we all know what a most suitable material *gravel* furnishes for the construction of our public and garden walks, and its utility in subterraneous draining,—and the uses to which, those isolated pieces of *conglomerates*, and *blocks*, and *boulders*, that are often so unaccountably to be met with on our plains, are applied, in the construction of what are called *dry-stone*, and other kinds of dykes, in the absence of other materials, are also well known.

Even *the fine floating sands of the desert*, are not without their present uses,—while they move forward in their destructive career over one tract, may they not lay bare, and expose to the fertilizing influence of the solar rays, another? At all events, they become easy mediums of communication between the different *oasses*, (or fertile spots) of the great desert, if traversed, as they ought to be, by the help of those *living machines*, which Nature has so amply provided for the purpose.

"Mounted on the *Heiree*, or camel of the desert, (which resembles the dromedary, and is only distinguished from it by greater elegance of figure,) the Arab, after tying up his loins, his breast, and his ears, to protect himself from the blasts of a dangerous wind, traverses with the speed of an arrow that burning desert, the fiery atmosphere of which deeply affects respiration, and is almost sufficient to suffocate any unwary," and I may be allowed to add, unprepared "traveller."

Nothing, indeed, can give us a better idea of the almost inconceivable swiftness of those useful animals, which, the natives, who know well their value, consider, as they may well do, as "*a gift sent from heaven*," than the manner in which the Arab speaks of them in his figurative language. "When," says one of these rapid traversers of the desert, "you meet a *Heiree*, and say to the rider *Salem alik*, (peace be with you,) he is out of sight before he can return the *Alik salem*, for he flies like the wind."—*Malte-Brun's Universal Geography*, vol. iv. p. 161. *Ibid* 162.

just enumerating, that the works of disintegration and renovation are carried on. Even those terrific engines, called volcanoes, have been made to "minister to good," in another shape than that of preventives from the more fatal effects of earthquakes.

These also have been made the means of giving rise to *new formations*, in midst of their destructive energies; and, while they may have overthrown cities, and devastated provinces in one part of the globe, have been the operating cause, under the controlling care of Providence, of throwing up islands in the midst of the ocean, and of replenishing and enriching the soil in others. But the illustration of this, by a series of facts that cannot be disputed, as well as of another wonderful contrivance, in which Nature acts upon a grand and magnificient scale, in the reproduction and renovation of her works, (but by means very dissimilar,) I must reserve for another chapter.

In the mean time, it must be consoling to reflect,—that, from these, and other methods taken by the Great Creator and Conservator of the universe, to renovate and renew the materials of our globe, or to provide others to supply their place, after former creations have been wasted and decomposed by time, we have no reason to be afraid, that this spacious and curiously constructed fabric will be suffered to go to ruin—will be permitted to fall into *premature decay*:—that, to whatever changes and vicissitudes it may be exposed, and whatever revolutions and alterations shall take place on its surface, or, in its more integral parts, at the pleasure of its ALMIGHTY FORMER—HE, will not allow *one* particle, of the multitudinous host of particles that enter into its composition, to be lost, or become useless, until the wonderful combination shall have fulfilled all the purposes of His will, and HE shall have given commission to the angel—to proclaim to an astonished universe; that, TIME—as it regards the present order of things—SHALL BE NO LONGER!

ON THE DIAGRAMATIC METHOD OF TEACHING CHEMISTRY.

BY MR. MACLURE.

GENTLEMEN,—The late Mr. James Alexander, surgeon of this city, in his lectures on *Materia Medica*, had a method of explaining the *rationalia* of the chemical processes which occur in the *Pharmacopeia*, which I found to be of singular use in elucidating the subject, and in impressing it upon the youthful mind. I am not aware, but that he was the inventor *of it*, as I have seen in authors nothing *exactly* of the same kind, and *I know* that none of my other teachers in Chemistry ever used it. Having derived so much advantage from Mr. Alexander's prelections and demonstrations, and having observed others do the same, chiefly from the use of this instrument of tuition, I think it due, not only to the dead, but to the living, to present a specimen of it to the public, through the medium of your useful Magazine. I am fortunate enough to have in my possession very copious notes of Mr. Alexander's lectures, from which

he following examples ; and
ite sure, that, if adopted, in
tion with the more common
s of instruction, it will prove
great use, particularly in our
ics' Institutions.

plan consists of demonstrat-
n a black board, with a bit
, what takes place among the
s of bodies in every chemi-
cess, in a way somewhat si-
that which mathematicians
demonstrating mathemati-
lems.

ll first give an example from
simple process. It is taken
e formation of the muriate
tes, by mixing the carbonate
es with the muriatic acid, di-
ith three parts of water. In
gram, an atom of carbonic
represented by the letters
, carbonic acid being com-
f one atom carbon and two
xygen ; and an atom of the
d of barium or barytes by B
these, when combined in the
carbonate of barytes, by the
$\mathrm{C\,OO + B\,O}$, the sign *plus*,
g that the two elements of this
ce are in a state of chemical
The muriatic acid being
sed of an atom of chlorine
other of hydrogen, is repre-
by the letters C H ; the wav-
— over the carbonic acid sig-
hat it flies off during the pro-
the shape of carbonic acid

) + B O, Carbonate of barytes.
C H, Muriatic acid.

+ B O, Muriate of barytes,
is the substance sought. The
ic acid, which is a compound
orine and hydrogen, has a
er affinity for the barytes (a protoxid of barium) than the carbonic acid has, consequently the former seizes the base, and carbonic acid gas is evolved ; or, according to the new theory, the hydrogen of the muriatic acid combines with the oxygen of the barytes, forming water ; and the chlorine of the muriatic acid unites with the barium, and forms a pro-chlorid of barium, better known by the name of muriate of barytes, thus :—

$$\mathrm{C\,\overset{\wr}{O}\,O} + \left\{\begin{array}{l}\mathrm{B\,O} \\ \mathrm{C\,H}\end{array}\right\} \begin{array}{l}\text{Carbonate of barytes.} \\ \text{Muriatic acid.}\end{array}$$

The *bracket* between the O and the H shews that the oxygen and the hydrogen have combined, and formed water ; and *that* between the B and the C denotes that the barium has united with the chlorine, forming a pro-chlorid of barium, or, in other words, a muriate of barytes.

But the carbonate of barytes is a very scarce substance, and we are, therefore, obliged, in most cases, to prepare the muriate from the sulphate in the following manner. This process affords a much more complex example of Mr. Alexander's method of exhibiting the *rationale* to the eyes of his students.

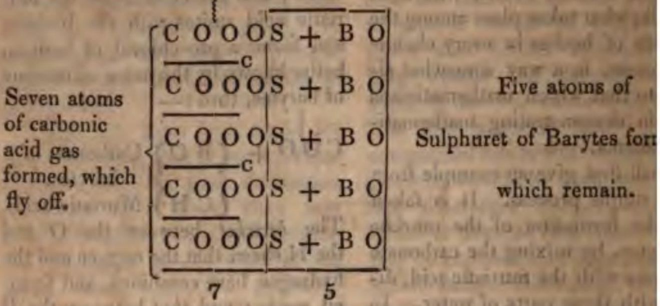
The use of carbon is necessary in this process ; and in the formula, it is represented by the letter C. Sulphuric acid is a compound of three atoms, oxygen, and one, sulphur ; and is therefore denoted in the formula by O O O S ; the barytes, being a protoxid of barium, is represented, as before, by B O ; and the two, when combined in the state of sulphate of barytes, by $\mathrm{O\,O\,O\,S + B\,O}$.

In the first stage of the process it is supposed that *five* atoms of the sulphate of barytes are used, and *seven* of the carbon as below :—

Five atoms of Sulphate of Barytes,
O O O S + B O
O O O S + B O
O O O S + B O
O O O S + B O
O O O S + B O

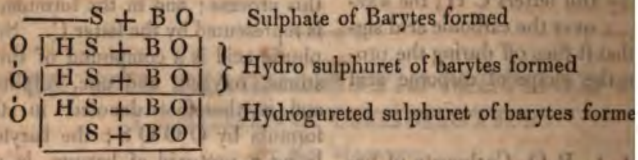
Seven ator Carbon,
C C
C C
C C
C

When treated as directed, their elements arrange themselves thus



Carbonic acid being a compound of one atom carbon, and two atoms oxygen; the seven atoms of carbon, supposed to be used, combine with *fourteen* out of the *fifteen* atoms of oxygen formerly united, in the shape of sulphuric acid, with *five* atoms of sulphur; and thus *seven* atoms carbonic acid gas are formed, which evolve; and each of the *five* atoms sulphur combines with each of the *five* atoms protoxid of barium, and forms *five* atoms of the sulphuret of barytes; which remain to be operated upon next stage of the process.

In the second stage the five of sulphuret of bartyes are col and boiling water is poured them. Water being compo one atom hydrogen, and on gen, it comes to be represent the letters H O. Suppose atoms of water to be poured up five atoms of the sulphur barytes, obtained as the res last stage—what takes place r represented thus :—


S + B O
O H S + B O
O H S + B O
O H S + B O
S + B O
Sulphate of Barytes formed
Hydro sulphuret of barytes formed
Hydrogureted sulphuret of barytes forme

In this stage, as was said before, boiling water is poured upon the sulphuret of barytes. Three particles of this water are supposed to be decomposed—their three atoms of oxygen combine with an atom of sulphur and form one atom of sulphuric acid, which, immediately uniting with an atom of barytes, forms a particle of insolubl phate of barytes. Two ato the hydrogen of the decom water unite with two atoms c phur and form *sulphurete drogen*, which, again unitin two particles of barytes, form atoms of the hydro sulphuret rytes. The other particle of tl engaged hydrogen attaches itself to the remaining two atoms of sulphur and forms a super-sulphuret of hydrogen which, combining, with the remaining two particles of barytes, forms a hydrogureted sulphuret of barytes.

In the third and last stage of this process, muriatic acid is poured upon the compounds resulting from the second stage viz. hydro-sulphuret of barytes, and hydrogureted sulphuret of barytes, and what takes place may be represented thus :—

$$\text{fly off}\left\{\begin{array}{lc|l} H\,S & + & \overbrace{B\,O—H\,C} \\ H\,S & + & \overbrace{B\,O—H\,C} \\ H\,S\,S & + & \overbrace{B\,O—C\,H} \end{array}\right.$$

In this formula the hydrosulphuret of barytes is represented by $H\,S + B\,O$; the hydrogureted sulphuret by $H\,S\,S + B\,O$; and the muriatic acid, being composed of hydrogen and chlorine, by the letters $H\,C$.

Now, upon these substances being put together under favouring circumstances, according to the old theory of the process, the muriatic acid having a stronger affinity for the *base*, barytes, than the sulphureted hydrogen has, the latter is expelled, flying off in the shape of gas; and the former unites itself with the barytes, and the substance wanted viz. the muriate of barytes is produced, and remains in solution.

But according to the new theory, the chlorine of the muriatic acid combines with the base of the barytes, forming a pro-chlorid of barium, or muriate of barytes; while the hydrogen of the acid unites with the oxygen of the barytes, composing water; and the sulphureted hydrogen is evolved in the shape of a foetid gas.

But in the second stage we had *two* particles of sulphur combined with one of hydrogen, forming a supersulphuret of hydrogen, which, combined with two particles of barytes, composed a hydrogureted sulphuret of barytes. This likewise is decomposed upon the addition of muriatic acid. But the supersulphureted hydrogen cannot fly off, in its present state, with its volatile companion. What then becomes of it? Why, it parts with an atom of its sulphur; this is found at the bottom of the vessel, and the supersulphureted hydrogen being now reduced to the state of volatile sulphureted hydrogen gas, is evolved with the rest.

It is impossible to make all this so plain on paper, as a lecturer could do by reiterated verbal explanations in a class room—but it is hoped that the above demonstrations are sufficiently clear to convince all who are acquainted with the subject, that such an instrument of instruction must be a very substantive aid to experimenting and written illustration.

Mr. Alexander, in his ardour for communicating clear and lasting notions to his pupils, in this his favourite science, had also a kind of game, resembling back-gammon or chess, by which he caused his pupils to imitate, in a very amusing way, the play of the elements, in the decomposition of old, and formation of new compounds, but I have not time, at present, for a description of it.—I am, GENTLEMEN,

Your obt. servt.

W. MACLURE.

42, York Street, 1st August, 1826.

MISCELLANIES.

Voyage of Discovery.—The Board of Admiralty have determined on fitting out another expedition to the Arctic Seas. The direction and immediate objects of the intended expedition, however, are different from those of the former voyages, and the promotion of the interests of our fisheries forms a very material inducement for the present undertaking. Our knowledge of Spitzbergen is almost entirely confined to its western coast, and a wide field for discovery remains unexplored on the eastern shores of that island. The first object, therefore, of the intended expedition, is the survey of its eastern coast, where it is expected that new and prolific fishing-ground may be discovered, which will be attended with great benefit to our northern fishery, the seas on the western side of Spitzbergen being nearly exhausted. Captain Parry has been selected for this interesting survey, and the Hecla is to be prepared for the performance of this service during the next year. An ultimate and still more interesting object is subsequently to be attempted, which will require all the energy and enterprise of the distinguished officer to whom this service is to be intrusted. We understand the Hecla will take out with her, boats or small vessels of peculiar construction, in which Captain Parry and a party of the Hecla's officers and men are to attempt actually to reach the North Pole, leaving the ship in the neighbourhood of Spitzbergen. This attempt is made at the suggestion of the Royal Society.

The Digestion.—About two years ago, Messrs. Breschet and Edwards endeavoured to shew before the Philomathic Society at Paris, the causes of the existing difference of opinion with respect to the influence of the nervous system, in producing the phenomena of digestion. Since that time they have made experiments (conjointly with Dr. Vavasour,) which seem to have decided the question; and of which they state the following to be the principal results: "1. The division of the eighth pair of nerves considerably retards, without stopping, the transformation of food into chyle. 2. This slackening of the digestive labour results principally from the paralysis of the muscular fibres of the stomach. 3. The vomitings which frequently supervene, on the division alluded to, result from the paralysis of the muscular fibre of the œsophagus. 4. The re-establishment of active chylification, after the division, by the aid of an electrical current, results not from the chemical action of that agent, but rather from its occasioning those movements which are necessary to renew the surface of the alimentary matter, and to bring in turn the particles which compose it, in contact with the coats of the stomach. 5. By a mechanical irritation of the interior end of the nerve, analagous results may be obtained." The conclusion drawn from the experiments that have been made, is, that one of the principal functions of the pneumo-gastric nerves it to preside over the movements of the stomach; movements which accelerate digestion, by facilitating the contact of the gastric juice with the various parts of the alimentary matter.

Valuable Discovery.—One of the most simple and useful discoveries in agriculture, is to mix layers of green or new-cut clover, with layers of straw in ricks or stacks: thus the strength of the clover is absorbed by the straw, which thus impregnated, both horses and cattle eat greedily, and the clover is dried and prevented from heating. This practice is particularly calculated for second crops of clover and rye grass.

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Communications (post paid) must be addressed.

AITKEN, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE,

CONDUCTED BY
A Committee of Civil Engineers and Practical Mechanics.

> "Come bright Improvement! on the car of Time,
> And rule the spacious world from clime to clime;
> Thy hand-maid arts shall every wild explore,
> Trace every wave, and culture every shore."—*Campbell.*

No. CXL. *Saturday, 26th August,* 1826. Price 3d.

PREMIUMS

OFFERED FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE, BY THE LONDON SOCIETY OF ARTS, &c.

THE object of this Society, as most of our readers already know, is to promote the Arts, Manufactures, and Commerce of this Kingdom, by giving honorary or pecuniary Rewards, as may be best adapted to the case, for the communication to the Society, and through the Society to the public, of all such useful Inventions, Discoveries, and Improvements, (whether specified in these premiums or not), as tend to that purpose: in pursuance of this plan, the Society have already expended upwards of a *Hundred Thousand Pounds,* derived from voluntary subscriptions and legacies.

The great object of the Society in rewarding individuals, is to draw forth and give currency to those inventions and improvements which are likely to benefit the public at large. Candidates are, therefore, requested to observe, that if the means by which the respective objects are effected require an expense or trouble too great for general purposes, the Society will not consider themselves bound to give the offered reward; but though they expressly reserve the power, in all cases, of giving such part only of any premium as the performance shall be adjudged to deserve, or of withholding the whole if there be no merit, yet the candidates may be assured the Society will always judge liberally of their several claims.

The Society by no means restrict their liberality to the subjects for which premiums are specially offered, but will take into consideration, and will reward by a bounty proportioned to its merit, any communication, the subject of which is of a practical nature, and calculated to promote the public good.

All communications are to be made by letter, addressed to the secretary; and are to contain full and particular details, according to the nature of the subject, as well as accurate descriptions of such drawings and models as form part of the communication: the models to be sent *carriage paid.*

In those cases in which certificates are required to be produced in claim of premiums, they should be expressed, as nearly as possible, in the words of the conditions attached to the respective premiums, and be signed by *disinterested* persons, who have a positive knowledge of the facts stated.

PREMIUMS IN CHEMISTRY, DYEING, AND MINERALOGY.

Increasing Steam.

48. For a method, verified by actual experiment, of increasing the quantity or force of steam in steam engines, provided the risk of accidents be not increased, and the whole amount of the expenses be considerably lessened:—*the Gold Medal, or Fifty Guineas.*

Prevention of Smoke.

49. For a method superior to any now before the public, of preventing the emission of dense smoke, from the chimnies of steam engines, breweries, and manufactories;—*the Gold Medal, or Fifty Guineas.*

Certificates to be produced to the Society, that the means proposed have been found to succeed in practice.

Test for Arsenic.

50. For a test for arsenic in solution, superior to any hitherto known;—*the Gold Medal.*

Any communication in claim of this premium must include a method of detecting arsenic, not only in its usual form of white arsenic, or arsenious acid, but also in the state of arsenic acid, and of the soluble salts formed by the combination of arsenious and arsenic acids with alkaline substances.

Preventing the ill effects of Smelting Ores.

51. For the most effectual method of preventing the ill effects arising to vegetation and animal life, from the sulphureous arsenical or other noxious fumes disengaged in smelting the ores of copper, zinc, lead, tin, iron, &c. in the large way; and, if possible, of converting those pernicious fumes to useful purposes, in a manner superior to any hitherto known or in use;—*the Gold Medal, or Fifty Guineas.*

A full account of the process employed will be required, together with certificates of its having been successfully carried into effect.

Fine Bar-Iron.

52. To the person who shall make the greatest quantity of bar-iron, not less than ten tons, with coke, from coke pigs, equal in quality to the best iron imported from Sweden or Russia, and as fit for being converted into steel;—*the Gold Medal, or Fifty Guineas.*

Samples to be produced to the Society, not less than one quarter of a hundred weight, with certificates that the whole quantity is of equal quality.

Refining Copper from the Ore.

53. For a method of separating, purifying, and refining copper from the ore, so as to render it fit for those purposes to which fine copper is now applied, and by a process cheaper than, and superior to, any hitherto known or in use;—*the Gold Medal, or Fifty Guineas.*

Certificates to be produced to the Society that not less than three tons have been so prepared and refined, and a quantity of not less than 14 lbs. of the copper so refined.

Refining Zinc from the Ore.

54. For refining zinc from the ore, by a process superior to any hitherto known or in use, and rendering it fit for the purpose of making fine brass;—*the Gold Medal, or Fifty Guineas.*

Conditions the same as in the preceding.

Preparing Brass.

55. For a method of making

brass from materials the produce of Great Britain or Ireland, of superior quality to that commonly manufactured in this country ;—*the Gold Vulcan Medal, or Thirty Guineas.*

A full account of the process to be produced to the Society, and of the ingredients employed, together with their proportions, and certificates that one ton has been so manufactured, and a sample of the brass, not less than 14 lbs.

Improved Earthenware Crucibles.

56. For manufacturing earthenware crucibles which shall not be liable to crack in the fire, and shall be capable of enduring the action of fluxes, and higher degrees of heat than those now in use, and shall not be too expensive ;—*the Gold Vulcan Medal, or Thirty Guineas.*

A full account of the process to be produced to the Society, and of the materials employed, with satisfactory certificates of the crucibles having been found to answer in use, and Specimens of the crucibles, with covers of the same material.

Improved melting Pots.

57. For manufacturing melting pots, for founders in brass, iron, and other metals, superior to those now in use, and not too expensive ; —*the Gold Vulcan Medal, or Thirty Guineas.*

Conditions the same as in the preceding premium.

Purifaction of Coal Gas.

58. For a method of purifying the inflammable gas procured from coal, superior to any now in use ; —*the Gold Vulcan Medal, or Thirty Guineas.*

A full account of the process to be produced to the Society, with Certificates of its fully answering the intended purpose.

Refining Whale or Seal Oil.

59. For an effectual method of purifying whale or seal oil from the glutinous matter that incrusts the wicks of lamps, and extinguishes the light, though fully supplied with oil; provided that such purified oil resists congelation in an equal degree with the unpurified ;—*the Gold Medal, or Fifty Giuneas.*

A full account of the process to be produced to the Society, and certificates that not less than twenty gallons have been purified according to the process delivered in, together with two gallons of the oil in its unpurified state, and two gallons so refined.

Oil for Chronometers.

60. For a method, verified by actual experiment, of rendering oil more fit than any now in use for chronometers and watches, particularly in being less liable to become thick or rancid ;—*the Gold Medal, or Fifty Guineas.*

A full account of the experiments to be produced to the Society, and of the process employed, with satisfactory certificates, together with a specimen of the oil.

Crown Glass.

61. To the person who shall make crown or window glass equally transparent, and as free from blue and green colour, as the best German sheet ;—*the Gold Vulcan Medal, or Thirty Guineas.*

Certificates to be produced to the Society, that not less than two cwt. have been made, together with one whole plate and two of the largest squares that can be cut, and a full account of the proportions of the ingredients, and of the process of manufacture.

Flint Glass.

62. To the person who shall make flint glass free from veins, as dense and transparent as the best now in use, and quite fit for the purposes of opticians ;—*the Gold Medal, or Thirty Guineas.*

A full account of the process, with certificates that not less than 20 lbs. have been made, and that object glasses, at least three and a half inches in diameter, have been manufactured of the same, together with specimens of the glass in its rough and manufactured state, to be produced to the Society.

Indelible Ink.

63. For a method of making a black writing ink, superior to any at present known, and indestructible by chemical applications;—*the Silver Medal, or Fifteen Guineas.*

Certificates that not less than two gallons of such ink have been actually prepared with a full detail of the process of making it, and two quarts of the ink to be produced to the Society.

Printers' Ink.

64. For the best composition for printers' ink, superior to any hitherto in use;—*the Gold Medal, or Thirty Guineas.*

Certificates that 112 lbs. of such ink have been made, with a full account of the process employed, and 6lbs. of the ink to be produced to the Society.

Copper-Plate Printers' Ink.

65. For the best composition for printers' ink, superior to any hitherto known, and fit for the finest kind of copper-plate printing;—*the Gold Medal, or Fifty Guineas.*

Certificates and conditions the same as for the last premium.

Rendering Leather Water-proof.

66. For a method, superior to any now in use, of rendering leather water-proof, without injuring its texture or pliability;—*the Silver Medal, or Fifteen Guineas.*

A full account of the process, with samples of the leather in its unprepared and prepared state, to be produced to the Society.

Preserving Seeds of Vegetables.

67. For a method, superior to any at present known, and verified by sufficient trials, of preserving seeds of plants, during a long sea voyage, in a state fit for vegetation;—*the Gold Medal, or Thirty Guineas.*

Preserving Provisions from becoming Rancid or Rusty.

68. For the best, cheapest, and most efficacious method, superior to any hitherto known, of preserving salted provisions from becoming rancid or rusty;—*the Gold Medal, or Thirty Guineas.*

A full description of the method, with proper certificates that it has been found on repeated trials, to answer the purpose intended, to be produced to the Society.

69. For a method of curing or preserving meat, during long sea voyages, superior to any now in use;—*the Gold Vulcan Medal, or Thirty Guineas.*

Conditions the same as for the preceding premium.

Preserving Iron from Rust.

70. For a cheap composition, superior to any now in use, which shall effectually preserve wrought iron from rust;—*the Gold Medal, or Fifty Guineas.*

A full description of the method of preparing the composition, with certificates that it has stood at least two years unimpaired, being exposed to the atmosphere during the whole time, with one pound weight of the composition, to be produced to the Society.

Preventing the Dry Rot in Timber.

71. For a certain method of preventing the dry rot in timber, superior to any hitherto known;—*the Gold Medal, or Fifty Guineas.*

The particulars of the method of prevention, confirmed by repeated experiments, to be produced to the Society.

Preventing the Mildew in Paper or Canvas.

72. For a process to be used in the manufacture of paper or canvas,

or some application to be made to manufactured paper or canvas, which shall effectually prevent it from becoming mildewed ;—*the Gold Medal, or Fifty Guineas.*

A full acconnt of the process employed, with certificates and other evidence of its efficacy, to be communicated to the Society.

Preventing the destructive Effects from Moths.

73. For a cheap, easy, and effectual method, verified by repeated and satisfactory trials, of preventing the destructive effects occasioned by moths and other insects, in furs, woollens, and other articles, superior to any hitherto known or practised ;—*the Gold Medal, or Thirty Guineas.*

The accounts, with proper certificates, to be produced to the Society.

(To be Continued.)

EFFECT PRODUCED BY THE CHLORURE OF BARYTES WHEN MIXED WITH ACETATE.

BY M. VAUQUELIN.

I HAD designed to prepare a large quantity of chloric acid, for the purpose of forming combinations with it, and studying their properties. For this purpose I followed the process of causing the chlorure of barytes to act on the phosphate of silver ; but their action being very slow, I employed a small portion of acetic acid, to accelerate it. The operation then took place with the greatest facility, especially when seconded by a gentle heat.

When I had completely separated the chlorure of barytes from the chlorate, I evaporated the latter to dryness, and after re-dissolving it in water, I put aside one part of the solution, and decomposed the other with sulphuric acid : I obtained chloric acid, with which I made many combinations.

I evaporated and crystallized the portion of chlorate of barytes which I had reserved. This being done, I desiccated a certain quantity in order to examine the water of crystallization. I put two grammes of the latter into a crucible of platina, which I exposed to the fire, with a view to determine the loss sustained by that salt during decomposition, which would have given me the quantity of oxygen, at least in an approximative manner, for I already knew that of the barytes. Not long after this salt was exposed to the fire a detonation took place, with a report equal at least to that of a gun. The furnace was broken; the crucible of platina, though very thick, was cracked in several places longitudinally ; the bottom which had been flat, was lengthened out into the shape of a cone, and its cover projected against the moulding of a chimney piece, assumed exactly the form of the latter.

Though this circumstance could not but surprise me, yet upon reflecting on the manner in which I had observed the chlorate of barytes to act upon burning coals, my surprise subsided. It is not fused like chlorate of potash, but detonates quickly and with noise, even upon those parts of the charcoal where no sign of combustion is any longer to be seen.

On inquiring into the cause of this detonation, I conceived at first, that it consisted in the rapid disengagement of oxygen; but as chlorate of potash prepared directly with my chloric acid, exhibited the same phenomenon, though it is not presented by that which is made by the ordinary process, we must seek the cause elsewhere; and I soon discovered that to the acetate of barytes it must be attributed.

We cannot, therefore, avoid believing, that acetic acid employed to hasten the operation does not confine itself to the dissolving of the phosphate of silver, as might be supposed; but it likewise decomposes part of the chlorate of barytes, expelling or decomposing the acid which it contains.

From this statement it follows, that acetic acid must never be employed in the preparation of chloric acid; for, independently of the dangerous accidents which may result from it, the acid thus obtained is not pure, any more than the combinations which are made with it.

M. V.

* * *

ON THE USE AND DECLENSION OF THE GÆLIC NOUN.

Gentlemen,—In No. CXXXVII of your useful little work, we find a letter addressed to us, requesting a solution of some difficulties in the use and declension of the Gaelic Noun. This letter, as we deem it one of the first maxims of common civility, that an honest inquiry should receive at least an honest reply, we have here endeavoured to answer.

To Mr. Celticus, Glasgow. Sir, Ye have devolved upon us a task which, we fear, we shall not be able, to the satisfaction of the "antiquarian and philosopher," to discharge. "Ossianic situation" does not necessarily imply Ossianic powers, much less grammatical erudition: your questions we have, however, not overlooked: for the sake of symmetry we find it requisite to ingeminate them.—"When does the substantive assume the aspirating *h*, and when does it reject it?" To answer this query satisfactorily, it would require a protracted analysis, but we must be compendious. 1. The noun assumes the aspirating *h*, when preceded by an adjective, as *duine*, a man; *deadh dhuine*, a good man. 2. Masculine nouns beginning with a consonant assume the aspirating *h*, in the Gen. and Dat. sing. as *fear*, a man; *an ſhir*, of the man: and femenine nouns in the Nom. and Dat. as *a bhean*, the woman; Dat. *mhnaoi*. 3. Nouns beginning with a vowel are aspirated by inserting the *h* between the article and the noun in the Nom. and Dat. of both genders, as *oighean*, virgins; *na h-oighean*, the virgins; *oiche* night; *na h-oiche*, of the night: likewise when the possessive pronoun *a'*, (her) precedes the noun, as *a' h-ighean*, her daughter. 4. The noun assumes the aspirating *h* in the vocative case invariably, except in nouns beginning with a lingual, which are generally in the primary form: as *'mhathair*, *'athair*, *'bhrathair*, *mhic*, *mhac*, *mhuc*, *&c.* 5. Patronymic nouns require the aspirating *h* as *Leathanach*, a Maclean; *Domhnullach*, a Macdonald; *Elamaich*, Elamites; *Judhaich*, Jews, &c.; and 6. *All* nouns beginning with a consonant *admit* of being aspirated; which is done by postfixing the *h* to the initial consonant, the *h* itself being never an independent radical letter. These, are the more prominent occasions on which the noun assumes "the aspirating *h*," but to give a definite, unexceptionable answer to the question is *out* of question quite: "sounds," as Johnson found, "are too volatile and subtile to admit of restraint." Were you yourself asked, when does the noun in English assume the labial *p*? your readiest answer would perhaps be, "whenever the rules of orthography require it." Of the Gaelic noun, the aspiration, not unfrequently depends upon the initial form, the initial form depends partly on the adjective, partly on the gender, partly on the case, and the case depends partly on the characteristic vowel. What philosopher, or antiquarian could we hope to follow us through these tortuosities? The second member of the question comes under. 2. "Does the substantive assume the aspirate when by itself invariably in the same manner as when with an adjective?" This question might, without fear of confutation, be answered by a *negative;* but a *mere* negative is a disingenuous reply when the querist has for his object a profusion of grammatical distinctions. An adjective therefore preceding the noun, as we have already observed, saddles the noun with the aspirate; as *duine*, a man; *deadh dhuine*, a good man; *suil*, an eye; *mor suil*, a big eye; *gealchos, cruaidh chos*, &c. And *vice versa*, as *mor*, big; *suil mhor*, a big eye; *cos gheal*, &c.; An article, a pass. pronoun, or a preposition thrusts both the noun, and its adjective into the aspirated form, as *a bhean bhochd*, thou poor woman; *don mhaoi bhoch'd*, &c.

3. Is the substantive differently aspirated when the adjective immediately precedes it, from what it is when the adjective follows?" As the *h* itself must not appear as an initial letter without a hyphen, it affects the aspiration of the noun little whether the adjective precedes or succeeds, it only occasions alternation of forms which the paradigm of the last solution may suffice to illustrate.

4 "Is the adjective subject to the same rules of aspiration as the substantive?" For *our* part we do not at present recollect any one exception; and indeed our Grammar protests, that "the changes on adjectives are made like those on nouns." Both admit the aspirate through all their numbers, genders, and cases. What think you, Mr. Celticus, shall we now *respire?* It must be *admitted* that we have *assumed*, and *aspired* a great deal. Our mountain language, you know, Sir, has a peculiar propensity to aspiration. This peculiarity makes it peculiarly inspiring, and nervous, and perhaps of all languages the fittest to express and engage the passions.

Your interrogatories we have by no means answered so copiously as might be done, but Stewart's Grammar will sufficiently supply the defect. You know, Sir, or at least ought to know, that to the summit of literature there is no way but by the bottom. None need hope to be admitted to the Elyssian fields of Celtic literature without a passport from Orthography, Etymology, and Syntax, or the constitution of things has changed since the ingression of

L. M'L.

The Island Coll, August, 1826.

LONDON UNIVERSITY.

One of the London monthly periodicals states, that the plan of the Institution will comprehend public lectures, with examinations by the professors; mutual instruction among the pupils, and the aid of tutors in those parts of knowledge which most require to be minutely and repeatedly impressed on the memory. It is intended, that the professors shall derive their income at first principally, and, as soon as may be, entirely, from the fees paid by their pupils; they will hold their offices during good behaviour. Professors will doubtless be found of eminent ability, and of such established reputation, as to give authority and lustre to their instructions, so that the University will not be wanting in the means of exciting and guiding superior faculties in their ascent to excellence, as well as of speedily and easily imparting the needful measure of knowledge to all diligent students. The number of the professors, the allotment of particular branches to individuals, and the order in which the lectures ought to be attended, are matters not yet finally settled, and some of them must partly depend, in the first instance, on the qualifications of candidates; others will permanently be regulated by the demand for different sorts of instruction. Some professorships may hereafter be consolidated; more are likely in process of time to be subdivided; many entirely new will doubtless be rendered necessary by the enlarged desire of the community for knowledge. The course of instruction will at present consist of Languages, Mathematics, Physics, the Mental and the Moral Sciences, together with the Law of England, History, and Political Economy;—and the various branches of knowledge which are the objects of Medical Education. In the classification of these studies, there is no intention to adhere strictly to a logical order, whether founded upon the subjects to which each relates, or on the faculties principally employed on it. Without entirely losing sight of these considerations, the main guide of the Council is the convenience of teaching, which for the present purpose is more important than a scientific arrangement; even if such an arrangement could be well made without a new nomenclature of the sciences, and a new distribution of their objects. For the good effects expected in other seminaries from discipline, the Council put their trust in the power of home, and the care of parents: to whom, in this Institution, which is equally open to the youth of every religious persuasion, the important duty of religious education is necessarily, as well as naturally, intrusted. That care, always the best wherever it can be obtained, will assuredly be adequate to every purpose in the case of the residents in London, who must be at first the main foundation of the establishment. When its reputation attracts many pupils from the country and the colonies, those means of private instruction and domestic superintendence, may be adopted, which have been found in other places to be excellent substitutes for parental care. The Council trust, that they are about to lay the foundation of an Institution well adapted to communicate liberal instruction to successive generations of those who are now excluded from it, and likely neither to retain the machinery of studies superseded by time, nor to neglect any new science brought into view by the progress of reason; of such magnitude as to combine the illustration and ornament which every part of knowledge derives from the neighbourhood of every other, with the advantage which accrues to all from the outward aids and instruments of libraries, museums, and apparatus; where there will be a sufficient prospect of fame and emolument to satisfy the ambition, and employ the whole active lives of the ablest professors; where the most eminent places in education may be restored to their natural rank among the ultimate and highest objects of pursuit; where the least remission of diligence must give instant warning of danger, and an attempt to pervert its resources to personal purposes cannot fail to cut off the supply sought to be perverted; where the inseparable connexion of ample income and splendid reputation, with the general belief of meritorious service, may prove at once a permanent security for the ability of the teachers, an incentive to their constant activity, and a preservative of the establishment from decay.

HINTS RESPECTING THE THEORY OF BLEACHING,

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. V.—PROCESSES FOLLOWED IN BLEACHING.

(CONCLUSION OF THE WHOLE.)

During the course of the essay, I have frequently mentioned the colouring matter of the several stuffs; were I to be asked what I understand by this colouring matter, I would answer, I do not mean any definite chemical principle, such as oxygen, or tanning, but use it as a general expression for oils, resin, gum, or other chemical constituents which may be tinged with any colour. Several of our illustrious modern chemists have attempted to shew that there exists chiefly in vegetables a proximate principle, distinct from every other constituent of plants, in which colour principally resides, and to which they give the name of colouring matter. The evidence which is adduced for the existence of such a principle, seems to me, to be extremely vague and doubtful, and there are facts which appear nearly conclusive against its existence. If there were such a principle, it ought, according to the analogy of some similar principles, to possess invariable characteristics by which it might always be recognised. Nothing like this, however, has yet been discovered. Certain vegetable colours indeed, such as red and blue, are uniformly affected in the same manner, by acids and alaklies, but does this prove that the blue and red are similar properties of the *same* colouring principle? does it not rather prove that those two colours are widely dissimilar, and give reason to infer, that the principles upon which they depend is also very different in some of its properties? Mr. Murray tells us that many vegetable products, possessed of deep or of vivid colours, agree in certain chemical relations: the colouring matter can be abstracted from them by the application of certain solvents: can be still farther transferred from these solvents to other substances, exerting affinities towards it; and this, without it being possible to refer the phenomena to actions exerted by any known proximate principle. But surely this evidence can never be admitted as proof of the existence of a separate principle. If the phenomena cannot be referred to the action of any *known* proximate principle, it may reasonably lead us to conjecture the existence of some such principle; but does it necessarily follow, that this must be colouring matter, distinct from the other constituents of the plant to which it gives colour? The colouring matter of vegetables, it is said, is scarcely ever found insulated, but is mixed or combined with other principles. It is obtained in a more simple and pure state by the action of those agents which are capable of dissolving it. But I would observe, that this supposed colouring matter has never, so far as I know, been obtained in a simple state unmixed with gum, resin, oil, or other known vegetable constituents, which, although it is not a proof of its non-existence, is sufficient to make us cautious in admitting what appears so doubtful. Sometimes the colours of vegetables are extracted by water, which must be cold, or warm, according to circumstances; for even in so simple a thing as this, there seems to be a diversity of affinities in this principle. But it is not always soluble in water, but recourse must sometimes be had to alcohol, and even in one instance to essential or expressed oil. Alkalies and acids also must sometimes be employed before its solutions can be effected. Now it can easily be conceived, that when it is in complicated combination with resin, gum, tannin, and the like, the operation of different chemical agents may be required, for its separation; but when once the separation is effected, it ought to exhibit common properties, otherwise it can never be esteemed a distinct principle.

It appears then, that we can receive but little light on the theory of Bleaching, from what has been written by Chemists, concerning the colouring matter of plants, considered as a distinct proximate principle, any more than from the vague hypothesis which philosophers have given concerning colour and coloured light. What is known concerning the operation of the Chemical agents used in Bleaching, is also founded chiefly on conjecture. When treating of these agents, and of the several processes of the art, I have already given the most probable rationale in the greater number of instances, and shall not now repeat what was then stated. The rationale of the action of the most important of those agents, namely chlorine, I have reserved for this place.

Berthollet, and most of the earlier chemists of the modern school, if we except Scheele, supposed, that what we call chlorine is a compound substance produced by a union of muriatic acid and oxygen, whence they denominated it oxy-muriatic acid, oxy-acuated muriatic acid. This account of the matter is now nearly abandoned by all the eminent chemists of the day, except Berzelius and perhaps Dalton. The most probable account is, that which has been illustrated at great length, and with much ingenuity, by Sir Humphrey Davy, and of the merit of which a most preposterous attempt has been made to deprive him by the French chemists, because Gay-Lussac and Theward, overawed by the authority of Berthollet, *argued against it* in their Recherches, Physico-Chimiques, while, all the time, they secretly believed it to be just. But if so, why did they not publicly say so, in contempt of Berthollet's advice and authority?

It will be proper to state as briefly as possible, the reasons for considering Davy's theory, to be the most plausible, if not the true account of the substance. Not the least striking of these is its conversion into muriatic acid, by union with hydrogen, while, during the change, it evolves no aqueous vapour. Sir H. Davy, and Dr. Henry, have satisfactorily proved that water is an essential ingredient in muriatic acid, as the latter has never been procured in an insulated elastic form. Berthollet makes the proportion of water as high as 34 per cent. but it is probable, that at a minimum, the proportion may be 25, as stated by Gay-Lussac and Theward. This view of the subject is opposed by Dalton. (*Chem. Phil.* i. 282.) He argues, that when the gasses which are not readily absorbed by water, are brought in contact with it, and exposed to heat, a portion of the fluid will be raised into their interstices, but if acids in the state of gas which can be absorbed by water readily, and in quantity, are placed in similar circumstances, there is a mutual attraction, and their consequent union produces an acid in the liquid form. It follows, he thinks unanswerably, that these acid gases of which the muriatic is one, so far from obstinately retaining their vapour, cannot be induced to admit any vapour at all in ordinary circumstances. But in making his experiments, Mr. Dalton does not seem to have been aware that his muriatic gas was previously saturated with aqueous vapour, as it unquestionably must have been, and could not on this account admit the absorption of an additional quantity. Would Mr. Dalton affirm, that muriate of lime contains no water of crystallization, because when a very small portion of water is added to its crystals, they become liquid? Now when it is recollected, that one cubic inch of hydrogen by union with very nearly two cubic inches of oxygen, forms a quantity of water, whose weight is to that of the real muriatic acid contained in two inches of the acid gas, as 26 to 100, we must conclude that the oxygen of the chlorine, if it contains any, most unaccountably disappears: or rather that it has no existence. Dalton has reasoned against this very plausibly, and supported his arguments by ingenius experiments, but he has been satisfactory answered by Mr. Henderson in a learned paper, for which he received a medal from the Royal Medical Society of Edinburgh.

Again, chlorine, when caused to exert its action on metals and inflammable substances, produces bodies which are essentially different from oxydes produced from the same substances. The most satisfactory proof of this position has been brought forward by Mr. J. Davy in a paper on the metallic combinations of chlorine. (*Phil. Trans.* 1812, 169.) He combined it with copper, tin, iron, manganese, lead, zinc, arsenic, and bismuth, in most cases in several proportions, but in no case did he obtain any substance resembling the oxides of the same metals. In examining Mr. J. Davy's experiments, Henderson has stated a curious coincidence of the new and the old theory. Horn-lead, he remarks, is said by Mr. J. Davy, to contain 74.22 lead, on 25.73 chlorine. According to Kirwan's Analysis, it has 76 of lead, and 18.23 of muriatic acid; which, by the new theory, can yield only 17.6 of chlorine. In this case, the proportions of lead seem to answer very well; but that of chlorine is over-rated, by 8.18 per cent. By Kirwan's Analysis also, horn-lead contains 5.77 of oxygen, which, on the principles of the old theory, are sufficient to form 25.64 of oxy-muriatic gas by union with muriatic acid. Is this, he asks, merely accidental?

The opponents of the new theory confess, that the strongest circumstance in its favour is, that charcoal is neither capable of decomposing chlorine gas, nor muriate of silver, at any temperature whatever; in which cases, the strong affinity of the charcoal, for oxygen ought to come into play where oxygen is present in the chlorine, or its compound. This plain, and one should suppose unanswerable fact, is opposed not by one equally plain and satisfactory, but by general reasoning on the known laws of chemical combination. Berzelius, (*Ann. of Phil.* ii. 256.) remarks, that the most simple explanation is not always the most accurate. If, indeed, we suppose that the radicle of muriatic acid has a stronger affinity for oxygen than charcoal has, there is no difficulty in explaining the want of action of charcoal on chlorine. But this supposition is evidently quite gratuitous, and can never be allowed to weigh in argument against an indubitable fact. The objections of Berzelius also, which are derived from the general chemical laws which he has established on extensive inductions, must be set aside; for it is contrary to every legitimate mode of philosophizing, to cause nature to bend to any artificial arrangements, which even the most eminent and profound philosophers may see cause to lay down. Nay, Dr. Thomson says that he can point out a complete agreement between those laws of Berzelius, and the theory of Davy. (*An. Ph.* vii. 27.) He has not, however, published such an explanation, and I am too young a chemst to be able of myself to perform what appears so arduous a task. But I have full confidence in the assertion of Dr. Thomson, so far as his known character as a chemist induces me to rely on him. I think then, that I am justifiable in stating, that the account of chlorine given by Sir H. Davy is, if not the truth, by far the most probable which has been published.

We are now prepared to consider the effect of chlorine in destroying colours, in the process of bleaching. Berthollet (*Ann. de. Chim.* ii.) supposes that it destroys colours by parting with its oxygen, which united with the colouring matters and produced their de-composition either in a gaseous state, in which case they were carried away by their valatising, or in a liquid form which the dash wheel could readily remove. Davy's explanation, however, is the more probable in so far as his theory of chlorine is so. He thinks, with Berthollet, that colouring matter is destroyed by uniting it with oxygen; but he thinks that the oxygen is wholly derived from the water which is always present in the chlorine preparations. This water is decomposed by double affinity: that, namely, of hydrogen for chlorine, and that of colouring matter for oxygen. The virtue of chlorine then seems to consist in its power of detaching oxygen from the water contained in the oxy-muriates of lime, magnesia, &c. Magnesia indeed being a compound of metal and oxygen, (according to his views of the composition of the earths,) the oxygen may be easily detached, as it is held by a very weak affinity. The chief circumstance therefore to which the bleacher should direct his attention in using the oxy-muriate, is that the salt which remains after the abstraction of the oxygen, should not act upon the fibre as it undoubtedly will, if not carefully managed.

Nothing could be easier than to extend these discussions, but as they are at best but vague conjectures, I consider that practical bleaching would receive but little advantage from prolonging them, and the chemical bleacher would assuredly rise dissatisfied from their perusal.

MISCELLANIES.

Academy of Medicine.—A committee of the Parisian Academy of Medicine has made a report on M. Lesueur's paper relative to his new mode of administering medicines. Cutaneous absorption is considered by M. Lesueur as, in many cases, the best method of introducing medicinal substances into the animal economy; but he thinks that instead of simple friction on the unbroken skin, the epidermis ought to be first removed by a blister; a precaution which renders the absorption certain. Fourteen detailed experiments, made before the committee, induce them to consider M. Lesueur's process capable of becoming eminently useful. Among other effects, they saw the acetate of morphine produce, in cases of chronic catarrh, cures, which the introduction of the same substance by the mouth would never have effected. One evident cause of the difference which results from M. Lesueur's mode of administering medicines is, that, by adopting it, they escape the changes to which certain substances are exposed by remaining in the stomach. A new committee, composed of five members, has been appointed by the Academy, for the purpose of repeating these interesting and important experiments.

Longevity of Animals.—A little treatise by Aristotle, on the length of the lives of animals, has recently been republished at Gottingen, with notes by Professor Schultz. These notes contain a summary of all that is known on the subject by the moderns. M. Schultz gives an account of some very curious experiments on *cœriæ epemeræ*; and although, of all vertebral animals, birds are those which have the shortest lives, he brings forward, in opposition to these beings of a few hours, the instance of a paroquet, carried in 1633 from Italy into France, which was still living in 1743, and which, consequently, was above 110 years old. He also quotes the no less remarkable fact of a fish, taken at Kayserslautern, in 1497, in a reservoir, where it had been deposited 267 years before; as appeared from a ring of copper, with which its head was encircled. Whales, which, according to Buffon, live for 1000 years, are not forgotten; but M. Schultz prudently observes, that the celebrated naturalist may perhaps have been deceived on that point.

Patent granted to John Stephen Langton, of Langton juxta Partney, Lincolnshire, Esq. for an improved method of seasoning Timber. August 11, 1825.—In this method of seasoning, the pieces of it are put into a long, vertical, air-tight vessel or cylinder, heated externally by steam, or by a water bath, which latter may be either brought to the proper temperature in the common method, or by the use of steam. For either of these methods the vessel or cylinder which holds the timber must be inclosed in a second vessel, prepared so as to contain whichever of the two mediums is preferred for communicating the heat. The internal vessel is to rise a little above this inclosing vessel, and is to be closed with a cover, made air-tight, and fastened down in any convenient manner; and in its centre is to be another small lid, in which is to be fixed a mercurial syphon gauge: there is also to be "a screw" fixed in it, by turning which a communication may be made with the external air, when the timber is to be removed. The top of the external vessel is to be covered with a flagged platform, on which those who are to put in and remove the timber are to stand; and from the part of the internal vessel which rises above this platform, a pipe, furnished with a stop-cock, is to go off sideways to a condensing vessel, below which is to be placed an air-tight vessel, for the reception of the liquor that runs from the condenser, and communicating with it by a tube: from the top of this receiving vessel a pipe ascends to an air-pump, and from its bottom another pipe goes to a water-pump, to be used occasionally when the vessel becomes filled with liquor, which is known by a glass tube, fixed to its upper part, which bends round at right angles, and enters into it at its two extremities.

The condensing vessel is composed of a number of vertical tubes, each having at its top, outside, a tunnel, between which and the tube a narrow interval is to be left for the passage of water, which is to be conveyed by separate pipes to the tunnels, and to be let trickle down the outsides of the tubes, to keep them cool. The tops of the tubes may be made to communicate with the main pipe, that leads from the timber vessel, either by separate pipes branching off from them, or by rows of lateral pipes into each of which a certain number of the vertical tubes are made to open. A similar set of intermediate pipes should be fixed at the bottom of the condenser, to form a communication from the lower ends of the tubes to the pipe that leads to the receiving vessel.

The vessel or cylinder that holds the timber, which is thirty feet or more in length, may be made of several lengths of cast iron, furnished with flanches, by which they may be fastened together air-tight with screws and nuts; and when it is to be exposed to steam alone, it should be of such strength as to be able to bear an external pressure of 15lbs. to the square inch; but when a water-bath is to be used, then the bottom of the vessel should be strong enough to bear a force of 30 lbs. to the inch, and the top be of the strength before-mentioned, and all the intermediate parts should be proportionably stronger as they are closer to the lower extremity. The bottom of this vessel should also be fastened down to the external vessel, so that, if the latter be filled with water while the former is empty, it may be prevented from rising from its place.

Small timber should be kept in the vessel twelve hours, exposed to the action of the air-pump and the heat, before it is examined; very large timber will require a week to complete its desiccation, and that of intermediate sizes a time between the two periods, proportionate to its dimensions.

The mercurial syphon gauge at the top of the apparatus will regulate the heat to be applied to the vessel, and also indicate when the operation is perfected. When it shews a depression of three inches of the mercury, the heat of the bath, or surrounding medium, is to be 130° Fahrenheit; when two inches at a temperature of 120° and when the mercury is depressed one inch, a heat of 112° is to be applied; but the heat in no case is to exceed 200°.

When it is desired to be known whether the timber is sufficiently exhausted of its juices, the stop-cock of the pipe, that goes to the condenser from the vessel that contains the timber, is to be closed; and if, in half an hour afterwards, no rise be observed in the mercury, the operation may be concluded to be completed.

A fine and well-preserved gold coin of King Edward III. was lately found by George Bridgood, a gardner, of Axbridge, while digging up some ground near that ancient town. Its present weight is exactly 118 grains troy; and it is about the size of a modern half-crown in circumference. Edward III. is said, by many historians, to have struck the first gold coins in England; but Hume says they are to be found so early as Henry III.'s time, about a century before. Guthrie's chronological tables say gold was first coined in 1344 (18th Edward III.): if they are correct, this piece may be one of the earliest, and most valuable.

Captain Manby's apparatus for conveying assistance to Ships in distress on a lee shore.—The committee of the Port of Plymouth Branch Society, for preserving the Lives of Seamen from Shipwreck, lately embarked from the Admiral's Stairs, on board the life-boat, for the purpose of proceeding in her to Port Wrinkle, to ascertain her qualities, and to witness a trial of Captain Manby's apparatus for conveying assistance to ships in distress on a lee shore; the result was, in both cases, highly satisfactory. A shot thrown by the mortar, charged with six ounces of gunpowder, carried the rope nintey-one fathoms in a straight line; and when the charge was increased to eight ounces, the elevation was very considerably greater, and the distance in a straight line 121 fathoms. The life-boat made much greater way through the water when rowed, than might have been expected from her appearance; and on her return a stiff breeze came on, accompanied by a heavy swell, through which she sailed swiftly and steadily. On nearing the shore at Cawsand, the plugs were drawn out, and the water admitted, in order to ascertain how low she would sink; and, although there were eighteen persons on board at the time, she did not drop above six inches; the water then ceased to flow into her, fully convincing the gentlemen on board of her perfect safety.

Colchester Philosophical Society.—An adjourned meeting of this Society, was held on Wednesday evening, the 21st of June, when the Rev. J. Sandays delivered a Lecture "On the Principles of Hydrostatics."

Ipswich Mechanics' Institute.—At the last general quarterly meeting of members at the Society's room, W. Batley, Esq. one of the vice-presidents, in the chair, a statement was read, of the balance in hand at the last meeting; of the money received for subscriptions, daily fines, and attendance at lectures; of the total expenditure during the quarter; and of the donations presented to the Institution during that period, with the names of the donors. Agreeably to the rules of the Institution, the names of the new committee-men, who have been elected by ballot on the preceding evening were also read; and the chairman stated that the number of members who had paid up their subscriptions amounted to 139, being an increase of twelve during the past quarter.

The body of a man has been found in a bog on the lands of Gallagh, near Newton Cellow, the seat of C. D. Bellow, Esq. in the county of Galway. The bog was about ten feet and a half deep, and the body lay about nine feet below its surface. It had all the appearance of a recent death when first discovered, excepting that the abdomen was quite collapsed; but on exposure to the atmosphere it decayed rapidly. The face was that of a young man of handsome features and foreign aspect: and his hair, which was long and black, hung loosely over his shoulders. The head, legs, and feet, were without covering, also the limbs as far as the knees and elbows. His dress was composed of the skin of some animal, laced in front with thongs of the same material, and having the hairy side inwards; and it is not impossible it might have been that of the moose deer. He had no weapon; but near him, at each side of the body, was found a long staff or pole, which it was supposed he had used for the purpose of bounding over the streams; and as the body was found near a rivulet, it was further conjectured by the peasantry, that the man had met his death accidentally in some such manner. The antiseptic power of bogs is well known, and the frequent discovery of human bodies in a high degree of preservation, in those of Ireland, has been often recorded. The finding of this body would not, therefore, require particular notice, nor would it probably have excited much attention at the time, but for the singularity of the costume; and this notice is the more necessary, as the dress no longer exists, having been buried with the body, an instance of thoughtlessness of which the better informed in Ireland are ashamed. The antiquity of these remains is shown by the great depth of bog under which they lay; but as the growth of bog must depend on various circumstances, as situation, humidity, soil, &c., that fact alone can give us no certain criterion of its age. On this point, perhaps, the rude dress in which the body was clothed is more likely to afford more satisfactory ground for conjecture. That it belonged to a period antecedent to the arrival of the English, may be concluded from the evidence of Girald Bury, who says the Irish were but thinly clad in woollen garments, barbarously shaped, and for the most part black, because the sheep of that country were usually of that colour; and, from the spirit of that author's work, we have little reason to suppose, that if any portion of the Irish in his time had been clothed in skins, he would not have failed to notice it. From these circumstances it is conjectured that the body was that of one of the Belgic inhabitants of Ireland, as it was in a district which they unquestionably inhabited, and the close skin dress was generally used by them.

Glass Penetrated by Water.—It has been sometimes thought that glass can be penetrated by water. Mr. Campbell verified the fact in his voyage to the South of Africa. He had two spherical bottles hermetically sealed, which he sunk in the sea to the depth of 1,200 feet, by attaching a sufficient weight of lead. When he wanted to bring them up again, ten men were employed in the operation for a quarter of an hour.—The two bottles came up full of water, which the enormous pressure of the liquid had forced through the glass.—*Revue Encyclopedique.*

Electricity of the atmosphere.—M. Pouillet has shewn that electricity is developed during the vegetation of plants, shewing itself the moment that the germ appears above ground. He, therefore, concludes that this is a fertile source of atmospherical electricity.

A noble plant of the Yucca Gloriosa, or Adam's Needle, 10 feet high, with upwards of 600 flowers is blooming in the garden of J. and T. Backhouse, Tanner-row, York.—Also, four other species of the same genus, draconis, filamentosa, agustifolia, recuwifolia.

The Stadium.—Scientific men have differed much with respect to the extent of the Stadium of which Strabo and the geographers of antiquity availed themselves to indicate the distances between different places. It is evident that the only way of determining the point was to examine the existing difference between places the position of which had not changed, and by the result to estimate the length of the ancient measure. A large and exceeding accurate map of Turkey, by M. Lapie, lately published in France, has completely resolved the problem; and it is now proved that the stadia of the geographers of antiquity, were according to the opinion adopted by Gosselin and rejected by Danville, 700 to the degree. Thus strabo reckoned that it was 200 stadia from Corinth to Argos; and Pausanias that it was 660 from Sparta to Olympia. These distances, allowing 700 stadia to a degree, are precisely those in the new map.

Of the quantity of matter in the Sun and Planets, and the force of gravity at their surfaces.—On first view, it almost appears impossible to determine the respective masses of the sun and planets, and to measure the height from which bodies fall in a given time, by the action of gravity at their surfaces. But the connection of facts with each other, often leads to results which appear inaccessible, when the principle on which they depend is unknown.

It was, therefore, perfectly natural even for astronomers to consider it impossible to determine the intensity of gravity at the surface of the planets, while the principle of universal gravitation remained unknown;* and it is just as natural for those who are unacquainted with mathematics and astronomy to consider the same thing impossible, even although they have heard of such a principle as universal gravitation. We shall, therefore, state what has been the result of the calculations of some of the first-rate astronomers of the present day on this curious and interesting subject.

From the fact that action is always accompanied by re-action, astronomers conclude, that gravitation among terrestrial bodies is the mutual tendency of the particles of matter to one another. And, from analogy, they think it perfectly reasonable to suppose, that this is true in all cases; and that the force of gravitation towards different bodies, the distance being the same, is proportional to the quantities of matter, or the masses of the bodies.

This supposition is the foundation of all the calculations respecting the masses of the planets; and from it formulas have been deduced for calculating the relative quantity of matter in such of the primary planets as have satellites revolving round them; but the quantity of matter in those that have no satellites can only be guessed at by the effect they produce in disturbing the motions of the other planets.

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* It was this discovery which rendered it practicable to measure the intensity of gravity at the surfaces of the planets.

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THE GLASGOW MECHANICS' MAGAZINE,

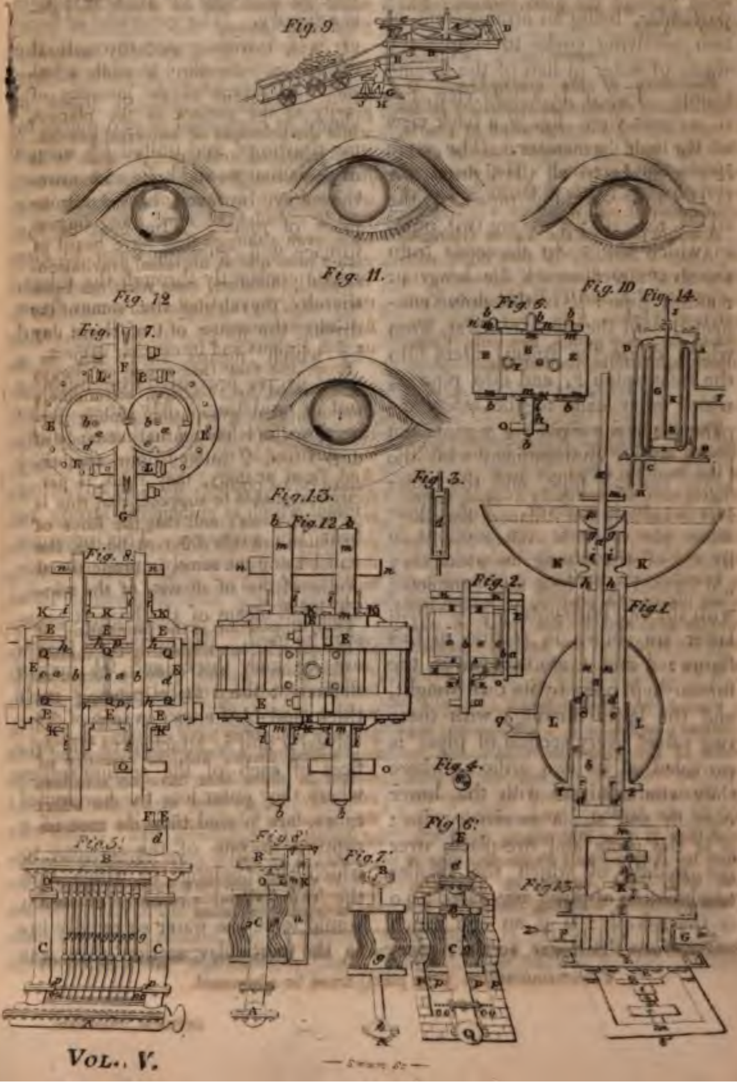
CONDUCTED BY

A Committee of Civil Engineers and Practical Mechanics.

> " The more widely Science is diffused, the better will the Author of all things be known, and the less will the people be tossed to and fro by the sleight of men, and cunning craftiness whereby they lie in wait to deceive."—*Mr. Brougham.*

No. CXLI. *Saturday, 2d September,* 1826. Price 3d.

MR. EVE'S IMPROVED STEAM ENGINE; FRICTION WHEEL; AND ARTIFICIAL PUPIL IN THE EYE.



— Swan Sc —

SPECIFICATION OF THE PATENT GRANTED TO JOSEPH EVE, LATE OF AUGUSTA GEORGIA, IN THE UNITED STATES OF AMERICA, BUT NOW RESIDING AT LIVERPOOL, IN THE COUNTY OF LANCASTER, ENGINEER, FOR AN IMPROVED STEAM-ENGINE, DATED NOVEMBER 24, 1825.

(Continued from page 390.)

SHEET second, figs 5′, 6′, 7′, and 8′, exhibit various views of my said second particular, and which I call my circulatory tubular steam-generator; as also of my said third particular, being an arrangement of two revolving cocks to supply the waste of water in lieu of the forcing pump. Fig. 5′ is a side view, fig. 6′ a front view, fig. 8′ a back view of the said generator. The same letters apply to all the figures. A is the lower conduit pipe: B the steam receiver: C C are two pipes in which the water descends from the steam receiver to the lower or conduit pipe: *d* is the dome connected with the steam receiver, from which dome the steam enters into the steam-pipe F, and into pipe E, which latter leads to the safety apparatus: *g g g g g g g g g g* are ten pipes which communicate with the lower conduit pipe, and the upper pipe or steam receiver. Fig. 7′ presents one of these ten sections in front, and the manner in which they are formed and bent and connected with the two horizontal pipes, which latter are shown in section in this figure: *h* and *i* are two valves, the former kept open by its own weight, and the latter floating; with these two valves every section of pipes is provided at its two orifices, where they communicate with the lower conduit and steam receiving pipe: *p* is the grate and fire-place, over the middle of which the smaller combination of pipes are placed: *o o* is the ash-pit: Q is an end which *screws into* the lower conduit pipe, by means of which the same may be cleaned out when necessary; the number of sections, number of pipes composing each section, and the manner in which the pipes are bent, is arbitrary. The generator or boiler is fed with water through the orifice, O. In fig. 5′ each of the two horizontal tubes or pipes is shewn as composed of two pieces in my drawings, and united by means of their flanges and bolts and screws; they may, however, be cast in one piece of metal. The heat of the furnace will cause the water to circulate constantly through the tubes, thereby preventing the steam from driving the water out of them, and by which means they are in a great degree prevented from burning out or oxidating. My tubes, in the sections, are from $\frac{1}{8}$ to $\frac{1}{4}$ inch thick, and 1 and 2 inches diameter; they may be of copper, iron, or any other metal which is sufficiently strong to bear the pressure. This pressure will be comparatively small, on account of the small size of the pipes, although steam of the highest pressure be used. My horizontal pipes, are $1\frac{1}{4}$ inch thick, and $9\frac{1}{2}$ inches diameter; the vertical pipes $\frac{3}{4}$ inch thick, and $4\frac{1}{2}$ inches diameter. The valves, *h* and *i*, attached to the orifices of each of the sectiou pipes where they enter into the horizontal tubes, are placed there in case of a rupture in one of the sections to which they belong, in which case the unbalanced pressure of steam would force the water so rapidly into the particular section that was ruptured, as to cause the valves to close, thereby preventing any waste of steam, and detaching the ruptured section from the rest of the generator, whereby the engine need not be stopped, but would only lose so much of its power as the proportion of one section to the remaining sound ones would be. The two large vertical, as well as the two large horizontal tubes, are imbedded in brick-work, and the sections only are exposed to the heat of the fire; therefore, no steam will be found or generated in the former, while the action of the fire will cause the steam and water to ascend rapidly through the small pipes into the steam receiver, while the water in the steam receiver, being heavier than the water combined with steam in the smaller pipes, will descend through the vertical tubes into the lower conduit tube, thereby causing a continual circulation through all the tubes, great and small. The steam will of course accumulate at the top, and through the dome find its way to the steam-pipe and safety apparatus. In case the circulation should be too rapid, and to prevent the possibility of the water being forced into the steam-pipe before it descends again through the vertical pipes, I have placed a piece of sheet iron, perforated with small holes, similar to a strainer, in the middle of the steam receiver, all across from end to end, shewn by a line across in the drawing, in fig. 7′. I have given to the small pipes in the sections the peculiar serpentine form, in order to enable the steam to rise to the top more rapidly than the water. My generators or boilers are supplied with water by means of one or more revolving cocks, to serve in lieu of the forcing pump, as shewn in sheet second, fig. 8′, where two cocks are represented, and which number I prefer: *n* is a vessel, filled with water, of any convenient shape, one side of which vessel is near the furnace, so as to keep the water warm. This vessel is connected with the generator through a tube entering at O, which is shewn in section in the drawing. This tube has two revolving cocks, K, and L, with a chamber between them, as is shewn by letter *m*. The cocks are made to revolve equally by cog wheels, geering into each other; so if cock K is open towards the water reservoir, cock L will be closed towards the tube leading to the generator; the chamber between the cocks will therefore be filled with water through cock K. By that time cock K closes, and L opens towards the generator; the water in the chamber will then descend through O, into the generator, by its own gravity, and its place be occupied in the chamber by steam from the generator. Cock K opens again towards the chamber, and L is closed towards the generator; the steam in the chamber will be condensed by the water now entering, or escapes into the water reservoir, *n*. This revolution goes on continually. If water be presented by cock L to the generator, and the said generator should be sufficiently full, the water being up to the dotted lines, in such a case the water will not be received, but remains in the chamber until part or the whole is wanted, the cocks constantly revolving. By this arrangement the water can be kept constantly at the desired height. Figs. 1′, 2′, 3′, and 4′, elucidate my improvements in the safety apparatus, as applicable to my tubular circulatory steam generator, or to any other boiler where high or low pressure steam is generated. Fig. 1′ shews a longitudinal section of the compound tube: *a* is the piston rod, screwed into the piston, *b*, which piston fits into the cylindrical tube, *e*, screwed or otherwise fixed at its base into the pipe that connects it with the steam receiver or boiler. O is a hole perforated through *b*, to allow the steam to ascend into the hollow space, *n*, above the piston, so that the pressure is equal on both sides with the exception of the piston rod, the diameter of which alone is unbalanced. The piece, *h*, screwed into the upper part of tube *e*, prevents the steam from ascending higher; another piece, *g g*, having a hollow space on the top, is screwed into *h*. Both these pieces have a hole bored in their centre, lengthways, of a diameter equal to the piston rod, *a*, to allow it to work up and down. The hollow space, *i i*, in the middle of the two pieces, *g* and *h*, is filled with packing so as to prevent any escape of steam along the piston. The hollow space, *p*, at top, is filled with oil: K is a basin, with water up to the dotted line, to keep the upper part cool, the weights with which the safety apparatus are intended to be loaded, are placed on the collar, *m*. The hollow tube, *e*, has longitudinal openings, as will be perceived by fig. 3′, which presents an outside front view of the apparatus, and through these openings the steam escapes whenever the piston, *b*, rises. These holes may be of an indefinite length and breadth; a jacket, F, represented by fig. 2′, which fits over the tube, *e*, and has likewise the same number of longitudinal holes cut through it, slides over the said tube, and by adjusting this jacket at X, the channel for the escape steam can be made narrower accordingly, as it may be desirable to have the piston rod raised more or less. The hollow vessel, L, or a vessel of any other form, slides or is otherwise fixed over the lower part of the apparatus, so as to intercept the steam from incommoding the upper part of it where the rod is loaded. The pipe, *q*, leads from this hollow vessel, L, to the steam condenser, or serves for the escape of steam. Fig. 4 presents an outside view of the piston. *a* is the rod already described: *c c* are packing rings, two on the upper side and two on the lower side. These rings press against the tube, *e*, in order to keep it steam-tight, so that no steam can escape through the longitudinal openings: *d d* are two pieces of metal, screwed on at the top and base of the piston, to confine the packing rings. Sheet third, fig. 5″, exhibits an elevation of my said compound steam-engine, with the aforesaid arrangement of cog wheels, constituting my said 5th particular. A is the furnace containing the steam generator or boiler: B is the dome on the top of the steam receiver, with the steam pipe, C, and safety apparatus, M. D is a cock upon pipe C, through which steam is admitted to the high-pressure engine, E. After having acted upon it, the said steam passes into the low pressure engine, F, constructed on my principle on a larger scale, so as to allow the steam to expand, and then act upon it as low pressure: E and F have pinion wheels, of an equal pitch, gearing into a spur wheel, G: these wheels determine the power given to each engine by regulating their motion with reference to the power required from each. The steam finds its escape at Z into the condenser H: the condensed steam or water runs through pipe I, by its own gravity, towards the two revolving cocks, K, whence it is conveyed back to the feeding pipe in the steam generator. V is an engine, constructed upon the plan elucidated by figs. 5 and 6, on sheet first, having two induction and two eduction pipes, which engine serves as a pump in this particular situation. Pipe W sucks the water from the well or river, and carries it into the refrigerator: X receives the water in the refrigerator, and carries it downwards; P is the bellows, fanning the fire by means of a band round the axle, Q, connected with two pulleys, R and S, or by any other contrivance: O is the valve and lever of the bellows, connected by rod N with the safety apparatus: T and U are pulleys, connected by a band to give rotatory motion to pump V; but many other contrivances may be used: L is a cock, which is only opened before the engine is set to work, in order that the air may be driven out of the pipes and condenser by the steam; the cock may then be shut, and the engine set to work: Y is a pipe leading from the safety apparatus to the condenser. Therefore if an engine be so contrived, and the boiler be once filled with water, the same water will answer for working the engine as long as all the pipes through which the steam and water circulate are tight; or at any rate the loss of water will be very inconsiderate. Now whereas I claim as my invention, first, the general arrangement of the rotatory engine, herein-before described, and, in particular, that conical shaped part which I have called a conical inner. 2dly, The particular construction of generators herein-before described. 3dly, The revolving cocks herein-before described, but only as applied to the purpose of supplying water to the generator instead of the ordinary forcing pumps. 4thly, In the new safety apparatus hereinbefore particularly described. And 5thly, in the particular arrangement of a compound engine, and the cog wheels regulating the high and low pressure, as hereinbefore described. And whereas these last-mentioned five parts of my invention, so claimed as aforesaid, are the five particulars alluded to in the former part of this specification; and such five parts, so claim as aforesaid, constituting my invention, and being, to the best of my knowledge and belief, entirely new, and never before used within that part of his said Majesty's United Kingdom of Great Britain and Ireland called England, his said Dominion of Wales, or town of Berwick upon Tweed, nor in any of his said Colonies and Plantations abroad, I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth comply in all respects fully, and without reserve or disguise, with the proviso in the said herein-before in part recited letters patent contained; wherefore I hereby claim to maintain exclusive right and privilege to my said invention.

FRICTION WHEEL.

GENTLEMEN,—On visiting one of the coal works in the Estate of Middlerigg, I was much pleased with a very complete friction-wheel, which I understood was erected by Laird Coburn, a very ingenious mechanic from Carron, thinking it worthy a place in your Magazine, I send you a short account of it.

It is used for running down coal waggons from the pit-head, (which is on a hill,) to the low ground, where the rail road commences. As the waggons that descend by the inclined plane are of a large size, and from four to six are sent down at once, the friction required to prevent their acquiring too great a velocity is very considerable, as they have nothing to bring up but the empty waggons.

As it is requisite for the safety of the person who attends these machines, that his position be such, as not to render him liable to be injured by a failure of any part of the apparatus, he is placed commonly behind the wheel, with a lever or brake to press upon the back of it, and thus retard its motion; but this throws more pressure than is necessary, on the journals occasioning greater tear and wear, and after all, in a wet day it is perfectly insufficient, the wet making it slip so easily.

The way in which these objections are obviated in the wheel in question, will be easily understood from the drawing, the wheel is kept dry by a proper roof.

A, fig. 9 the large pully or drum, over which the rope passes; B, the groove that receives the rope; C, the friction levers that retard the motion of the drum; D shews the part of a beam of the roof to which the levers are fixed; E, a perpendicular iron shaft connected to the levers, by the connecting rods F F, by which any required friction can be given to the drum A; G, a long lever by which the rack H gives motion to the perpendicular shaft E; I, a pinion by which a person acts on the rack; K, rollers to conduct the rope properly into the groove B.

The parts that are doted lines are under ground, and completely out of the way.

If you think this worthy a place in the Magazine, your giving it insertion will oblige,

Your's, &c.
WILLIAM BINNIE.

TABLES OF EQUALIZATION,

OF WEIGHTS, MEASURES, AND PRICES,

SHEWING THE EXACT PROPORTION BETWEEN THE NEW AND THE OLD.

By R. Wallace, A. M. Andersonian Professor of Mathematics, Glasgow.

(Communicated by the Author.)

In the following Tables of Equalization, the most exact proportions are adopted, viz. 277274 English Wine Gallons = 231000 Imperial Gallons; 277274 English Ale Gallons = 282000 Imperial Gallons; 277274 English Corn Gallons = 268,800 Imperial Gallons; 138637 Standard Scots Pints = 103404 Imperial Half Gallons; 2218192 Standard Wheat Firlots = 2197335 Imperial Bushels; 2218192 Standard Barley Firlots = 3205524 Imperial Bushels; 7000 Troy Pounds = 5760 Avoirdupois Pounds; 7000 Dutch or Scots Troy Pounds = $7621\frac{9}{11}$ Avoirdupois Pounds; 7000 old Tron Pounds = $10003\frac{7}{11}$ Avoirdupois Pounds; 32 Glasgow Tron Pounds = 45 Avoirdupois Pounds; 360 Standard Scots Ells = 372 Imperial Yards; and 3025 Standard Scots Acres = 3844 Imperial Acres. These tables are also Equalization Tables of Prices, as well as of Weights and Measures, but in the inverse ratio of the latter. Thus for example, 1 lb. Tron = 1.429091 lb. *Avoirdupois*, but when the price of a lb. Avoirdupois is = 1, the price of a lb. Tron is = 1.429091; also 1 lb. Avoirdupois = .699746 lb. Tron, but when the price of a lb. Tron is = 1, the price of a lb. Avoirdupois is = .699746; the whole of the Tables are calculated to the nearest millionth part of a unit.

	English Wine Gallon = Imperial Gallon.	English Ale Gallon = Imperial Gallon.	English Corn Gallon or Bushel = Imperial Gallon or Bushel.	Standard Scots Pint = Imperial half Gallon.
1	0.833111	1.017045	0.969438	0.748615
2	1.666222	2.034089	1.938876	1.497230
3	2.499333	3.051134	2.908315	2.245845
4	3.332444	4.068178	3-877753	2.994460
5	4.165555	5.085223	4.847191	3.743075
6	4.998666	6.102267	5.816629	4.491690
7	5.831777	7.119312	6.786067	5.240305
8	6.664887	8.136356	7.755505	5.988920
9	7.497998	9.153401	8.724944	6.737534

	Standard Wheat Firlot = Imperial Bushel.	Standard Barley Firlot = Imperial Bushel.	Imperial Gallon = English Wine Gallon.	Imperial Gallon = English Ale Gallon.
1	0.990597	1.445161	1.200320	0.983241
2	1.981195	2.890321	2.400641	1.966482
3	2.971792	4.335482	3.600961	2.949723
4	3.962389	5.780643	4.801281	3.932965
5	4.952986	7.225803	6.001602	4.916206
6	5.943584	8.670964	7.201922	5.899447
7	6 934181	10.116125	8.402242	6.882688
8	7.924778	11.561285	9.602563	7.865929
9	8.915376	13.006446	10.802883	8.849170

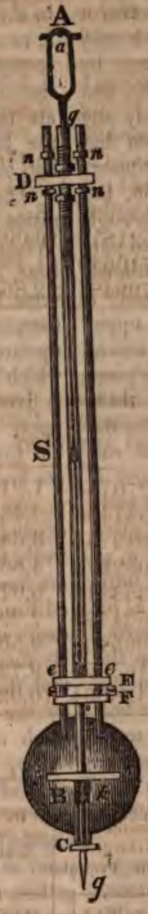
	Imperial Gallon or Bushel = English Corn Gallon or Bushel.	Imperial half Gallon = Standard Scots Pint.	Imperial Bushel = Standard Wheat Firlot.	Imperial Bushel = Standard Barley Firlot.
1	1.031525	1.340731	1.009492	0.691990
2	2.063051	2.681463	2.018984	1.383981
3	3.094576	4.022194	3.028476	2.075971
4	4.126101	5.362926	4.037968	2.767962
5	5.157626	6.703657	5.047460	3.459952
6	6.189152	8.044389	6.056952	4.151943
7	7.220677	9.385120	7.066444	4.843933
8	8.252202	10.725852	8.075936	5.535924
9	9.283728	12.066583	9.085429	6.227914

	Troy Pound = Imperial Pound.	Standard Dutch or Scots Troy lb. = Imperial lb.	Old Tron Pound = Imperial Pound.	Glasgow Tron Pound = Imperial Pound.
1	0.822857	1.088831	1.429091	1.40625
2	1.645714	2.177662	2.858182	2.81250
3	2.468571	3.266494	4.287273	4.21875
4	3.291429	4.355325	5.716364	5.62500
5	4.114286	5.444156	7.145455	7.03125
6	4.937143	6.532987	8.574545	8.43750
7	5.760000	7.621818	10.003636	9.84375
8	6.582857	8.710649	11.432727	11.25000
9	7.405714	9.799481	12.861818	12.65625

	Standard Scots Ell = Imperial yard.	Standard Scots Acre = Imperial Acre.	Imperial Pound = Troy Pound.	Imperial lb. = Standard Dutch lb.
1	1.033333	1.270744	1.215278	0.918412
2	2.066667	2.541488	2.430556	1.836824
3	3.100000	3.812231	3.645833	2.755237
4	4.133333	5.082975	4.861111	3.673649
5	5.166667	6.353719	6.076389	4.592061
6	6.200000	7.624463	7.291667	5.510473
7	7.233333	8.895207	8.506944	6.428885
8	8.266667	10.165950	9.722222	7.347298
9	9.300000	11.436694	10.937500	8.265710

	Imperial Pound = Old Tron Pound.	Imperial Pound = Glasgow Tron Pound.	Imperial Yard = Standard Scots Ell.	Imperial Acre = Standard Scots Acre.
1	0.699746	0.711111	0.967742	0.786941
2	1.399491	1.422222	1.935484	1.573881
3	2.099237	2.133333	2.903226	2.360822
4	2.798982	2.844444	3.870968	3.147763
5	3.498728	3.555556	4.838710	3.934703
6	4.198473	4.266667	5.806452	4.721644
7	4.898219	4.977778	6.774196	5.508585
8	5.597964	5.688889	7.741935	6.295525
9	6.297710	6.400000	8.709677	7.082466

GALBRAITH'S ADJUSTABLE COMPENSATION PENDULUM.



In the figure accompanying this, *g d* is the Zinc tube firmly fixed to a cross piece E at *d*. Within this tube, a steel rod A *g c d* passes rather freely, and is fixed to the cross piece at *d* within the tube. The top of this rod has a small piece of spring attached to it, or an oblong opening, within which, at its upper part, a piece of agate, or other hard stone may be place, on which the pendulum is suspended, after the manner of Captain Kater. It may be added, that motion may be communicated to it according to the plan proposed by Dr. Young, several years ago, by a single recoiling "stroke at the lowest point of the vibration," as described in the 39th number of Brande's Journal of Science, page 106. The model of this apparatus is now in the Royal Observatory at Greenwich, and the mode of determining the length of the pendulum by it, is shewn in the Philosophical Transactions for 1818. The Zinc tube passes through the upper traverse or cross piece of steel D, which may be fixed any where near its top, by two nuts *n*, *n*, the one above, and the other below, consequently any quantity of Zinc may be taken that may, by computation or experiment, be thought necessary. Again, the side rods *n*, *e*, pass freely through the traverses D, E, and are fixed permanently in F at *f*, but continued through it, and are let loosely a short way into the bob at its upper edge to keep it steady. By means of the nuts *n*, *n*, at the cross piece D, any required portion of these steel rods may be taken to effect the compensation. Another steel rod *o*, *q*, firmly fixed to the traverse F at *o* sustains the bob. In the middle of the bob is placed a flat piece of steel *b*, *b*, through which *o*, *q*, passes readily, and on which a tutular finger screw C D acts at *k*, for the purpose of raising or lowering the bob. It is made to act at the centre to avoid any error from the expansion or contraction of the bob by the effects of a change of temperature, which must have been the case, were this screw acting at the bottom of the bob, as in the common pendulum.

This is obviously an advantage, because, if it acted at the bottom, the expansion of the bob would raise its centre, and by that means the centre of oscillation, whereby the rate of the clock would be altered, which is by this method avoided, as the metal expands regularly round the centre, whence its centre of gravity remains the same, except as far as depends upon the expansion of the tube and rods already mentioned. The tube in this drawing, is cut away before and behind, so as to allow the air to act freely upon the central rod from *c* to *d*. This also admits of a slider *s*, to move up and down upon the central rod to complete the operation of bringing the clock to accurate time, after being nearly so, by the finger screw acting upon the bob in the usual manner.

The mode in which the compensation is effected, is as follows: When the central rod expands by heat, it lengthens and allow the traverse E to descend. At the same time, however, the zinc tube expands upwards, and raises the traverse D, which when the pendulum is in use, is fixed to the tube by the nuts *n*, *n*, upon the tube above and below. To this traverse D, the side rods are firmly attached by these nuts *n*, *n*, and consequently are allowed to expand downwards, which passing freely through the traverse E at *e*, are fixed in *f*, at *f*, but are continued through it till they enter the bob easily at its top to keep them steady. By this arrangement, it is obvious that the bob may be made to fall by the central and side rods, as much nearly as it is raised by the rod *o*, *q*, at B, therefore, another piece of steel rod *o* B, must be added to those formerly mentioned. Consequently, if the Zinc tube expand as much as all these taken together, reckoning the side rods as one, the compensation will be exact. By the known expansion of these metals, the proper quantities of each may be found very nearly, and if, upon comparison with celestial observation, the rate of the clock is not uniform, the compensation is imperfect, and the relative quantities of the metals may be varied by means of the nuts and screws, till it is so-

ARTIFICIAL PUPIL IN THE EYE.

It not unfrequently happens that in consequence of disease, the natural pupil of the eye, or central aperture in the coloured membrane called *iris*, through which light is transmitted to the nerve of vision, closes, so that the light no longer reaching its destination, sight is lost. It is also an extremely frequent consequence of inflammation of the eye, that the cornea, or lucid window on the front of the eye, by which light reaches the pupil, becomes white and opaque, either in whole or in part, so that the light is unable to reach the pupil, and of course the person is deprived of sight. When the whole of the cornea is reduced to this opaque state, sight is irrecoverable; but to restore sight when the natural pupil is closed, or hid by partial opacity of the cornea, a most ingenious operation was contrived about the beginning of last century, by Cheselden, an eminent anatomist and surgeon in London, namely, the formation of a new or artificial pupil, through which the light might pass into the interior of the eye.

This operation has since Cheselden's time been frequently performed, with various degrees of success. At one time, (indeed for a long track of years,) it was very much neglected, and doubts were even thrown over Cheselden's veracity; but of late years, the operation has been revived, and in a late number of one of the London Medical Journals, we notice a striking illustration of its utility, in a case operated on by Mr. Mackenzie of this city, in which vision has been restored, after both eyes had been deprived of sight, by severe accidental injuries and consequent inflammation.

The state of the eyes before operationis represented in fig. 10 and 11 of the plate, the centre of both corneas being so opaque as no longer to transmit the light. In the right eye, Mr. Mackenzie states, that he formed an artificial pupil by cutting out a small portion of the iris or coloured membrane of the eye, as is represented in fig. 12, through which, however, vision was not immediately restored, as the new pupil only brought into view a cataract or opacity of the crystalline lens, which it was necessary to remove by a subsequent operation; while in the left eye, he formed an artificial pupil by separating a small portion of the edge of the iris from its natural attachments, as is represented in fig. 13.

A common observer looking at an eye in either of the states thus operated on and represented in fig. 10 and 11, would probably pronounce it to be lost; but in such cases, the internal parts of the organ being sound, they are perfectly susceptible of impression from the light, could the light only reach them; this is prevented by the opaque condition of the centre of the cornea; but a portion of the edge of the cornea being transparent, and a new aperture or pupil being formed in the iris, by the operation, immediately behind the transparent part of the cornea, the light is thus enabled to make its way through the eye, reaching again the retina or expanded nerve of vision; making its impression on that nerve, as in the healthy eye; and thus by an operation of extreme simplicity and beauty, there is restored, if not the original and complete power of this precious sense, at least a distinct and useful degree of sight.

Optics fall completely with in our

province, and the formation of an artificial pupil is nothing more than a little mechanical adjusting, a nice mending of the finest of all optical instruments. Morand, in eulogizing Cheselden's invention of this operation, has made the following striking remark. "If Astronomy," says he, "assures a kind of immortality to him who by chance becomes the discoverer of a single star, the same honour may well be bestowed upon a Surgeon who knew by his genius to discover the whole heaven to a man who had been deprived of sight."

PNEUMATICS.

THIS term is restricted, in the present habits of our language, to that part of natural philosophy which treats of the mechanical properties of elastic fluids. The word, in its original meaning, expresses a quality of air, or more properly of breath. Under the article Physics we observed, that in a great number of languages the term used to express the animating principle, nay, the intellectual substance, the soul. It has been perhaps owing to some attention to this chance of confusion that our philosophers have appropriated the term Pneumatics to the science of the mechanical properties of air, and Pneumatology to the science of the intellectual phenomena consequent on the operations or affection of our thinking principle.

We have extended on the authority of present custom the term Pneumatics to the study of the mechanical properties of all elastic or sensibly compressible fluids, that is of fluids whose elasticity and compressibility become an interesting object of our attention: as the term Hydrostatics is applied to the study of the mechanical properties of such bodies as interest us by their fluidity or liquidity only, or whose elasticity and compressibility are not familiar or interesting, though no less real or general than in the case of air and all vapours.

We may be indulged in the observation, by the bye, that there is no precise limit to the different classes of natural bodies with respect to their mechanical properties. There is no such thing as a body perfectly hard, perfectly soft, perfectly elastic, or perfectly incompressible. All bodies have some degree of elasticity intermixed with some degree of ductility. Water, mercury, oil, are compressible; but their compressibility need not be attended to in order perfectly to understand the phenomena consequent on their materiality, fluidity, and gravity. But if we neglect the compressibility of air, we remain ignorant of the cause and nature of its most interesting phenomena and are imperfectly informed with respect to those in which its elasticity has no share; and it is convenient to attend to this distinction in our researches, in order to understand those phenomena which depend solely or chiefly on compressibility and elasticity. This observation is important, for here elasticity appears in its most simple germ, unaccompanied with any other mechanical affection of matters (if we except gravity) and lies most open to our observation whether employed for investigating the nature of this very property of bodies, or for explaining its mode of action. We shall even find that the constitution of an avowedly elastic fluid, whose compressibility is so very sensible, will give us the most distinct notions of fluidity in general, and enable us to understand its characteristic appearances, by which it is distinguished from solidity, namely, the equable distribution of pressure through all its parts in every direction, and the horizontality which its surface assumes by the action of gravity: phenomena which have been assumed as equivalent to the definition of a perfect fluid, and from which all the laws of hydrostatics and hydraulics have been derived. And these laws have been applied to the explanation of the phenomena around us; and the water, mercury, oil, &c., have been denominated fluid, because their appearances have been found to tally exactly with these consequences of this definition, while the definition itself remains in the form of an assumption, unsupported by any other proof of its obtaining in nature. A real mechanical philosopher will therefore attach himself with great eagerness to this property, and consider it as an introduction to much natural science.

Of all the sensible compressibles air is the most familiar, was the first studied, and the most minutely examined. It has therefore been generally taken as the example of their mechanical properties, while those mechanical properties which are peculiar to any of them, and therefore characteristic, have usually been treated as an appendix to the general science of pneumatics. No objection occurs to us against this method which will therefore be adopted in treating this article.

But although the mechanical properties are the proper subject of our consideration, it will be impossible to avoid considering occasionally properties which are more of a chemical nature; because they occasion such modifications of the mechanical properties as would frequently be unintelligible without considering them in conjunction with the other; and, on the other hand, the mechanical properties produce such modifications of the properties merely chemical, and of very interesting phenomena consequent on them, that these would often pass unexplained unless we give an account of them in this place.

By mechanical properties, we would be understood to mean such as produce, or are connected with sensible changes, motion, and which indicate the presence and agency of moving or mechanical powers. They are therefore the subject of mathematical discussion, admitting of measure, number, and direction, notions purely mathematical.

We shall therefore begin with the consideration of air.

It is by no means an idle question: "What is the air of which so much is said and written?" We see nothing, we feel nothing. We find ourselves at liberty to move about in any direction without any hinderance. Whence, then, the assertion that we are surrounded with a matter called air? A few very simple observations and experiments will shew us that this assertion is well founded. We are accustomed to say, that a vessel is empty when we have poured out of it the water which it contained. Take a cylindrical glass jar having a small hole in its bottom; and having stopped this hole fill the jar with water and then pour out the water leaving the glass empty, in the common acceptation of the word. Now throw a bit of cork or any tight body, on the surface of the water in a cistern, cover this with the glass jar held in the hand with its bottom upwards, and move it downwards, keeping it all the while in an upright position. The cork will continue to float on the surface of the water in the inside of the glass, and will most distinctly shew whereabouts that surface is. It will thus be seen that the water within the glass has its surface considerably lower than that of the surrounding water; and however deep we immerge the glass, we shall find that the water will never rise in the inside so as to fill it. If plunged to the depth of 32 feet, the water will only half fill it; yet the acknowledged laws of hydrostatics tell us, that the water would fill the glass, if there was nothing to hinder it. There is therefore something already within the glass which prevents the water from getting into it; manifesting in this manner the most distinctive property of matter, viz. the hindering other matter from occupying the same place at the same time.

While things are in this condition, pull the stopper out of the hole in the bottom of the jar, and the water will instantly rise in the inside of the jar, and stand at an equal height within and without, this is justly ascribed to the escape through the hole of the matter which formerly obstructed the entry of the water; for if the hand be held before the hole, a puff will be instantly felt, or a feather held there will be blown aside; indicating in this manner that what prevented the entry of the water, and now escapes, possesses another characteristic property of matter, impulsive force. The materiality of water is concluded from the impulse of a jet from a pipe. We also see the mobility of the former pent up and now liberated substance, in consequence of external pressure, viz. the pressure of the surrounding water.

Also, if we take a smooth cylindrical tube, shut at one end, and fit a plug or cork to its open end, so as to slide along it, but so tightly as to prevent all passage by its sides; and if the plug be well soaked in grease, we shall find that no force whatever can push it to the bottom of the tube. There is therefore something within the tube preventing by its impenetrability the entry of the plug, and therefore possessing this characteristic of matter.

In like manner, if after having opened a pair of common bellows, we shut up the nozzle and valve hole, and try to bring the boards together, we find it impossible. There is something included which prevent this, in the same manner as if the bellows were filled with wool; but upon opening the nozzle we can easily shut them, viz. by expelling this something; and if the compression is forcible, the something will issue with considerable force, and very sensibly impel any thing in its way.

It is not accurate to say, that we move about without any obstruction; for we find if we endeavour to move a large fan with rapidity, a very sensible hinderance is perceived, and that a very sensible force must be exerted, and a sensible wind is produced which will agitate the neighbouring bodies. It is therefore justly concluded that the motion is possible only in consequence of having driven this obstructing substance out of the way; and that this impenetrable, resisting, moveable, impelling substance is matter. We perceive the perseverance of this matter in its state of rest, when we wave a fan in the same manner that we perceive the inertia of water when we move a paddle through it. The effects of wind in impelling our ships and mills, in tearing up trees, and overturning buildings, are equal indications of its perseverance in a state of motion.

To this matter, when at rest we give the name of Air, and when it is in motion Wind.

Air, therefore, is a material fluid: a fluid, because its parts are easily moved and yield to the smallest inequality of pressure.

1. It always accompanies this globe in its orbit round the sun, surrounding it to a certain distance under the name of the atmosphere, which indicates the being connected with the earth by its general force of gravity. It is chiefly in consequence of the disturbing force of gravity. It is chiefly in consequence of this that it is continually moving round the earth from east to west; forming what is called the trade-wind, to be more particularly considered hereafter. All that is to be observed on this subject at present is, that, in consequence of the disturbing force of the sun and moon, there is an accumulation of the air of the atmosphere in the same manner as of waters in the ocean, in those parts of the globe which have the moon near their zenith or nadir; this happens successively, by the rotation of the earth round its axis going from the east to the west.

MISCELLANIES.

Gas, from Pyroligneous Acid.—It has lately been discovered that when wood acid is made to pass through an iron tube heated to ignition, and the acid allowed to enter the tube by drops in quick succession, gas of a very excellent quality, is obtained. This fact was first observed by Mr. Leet, of this city, whilst pursuing experiments on the purification of pyroligneous acid.—*Chester Paper.*

Mixture of Colourless Liquids producing a Black.—One of the most interesting phenomena in the operations of chemistry, occurs in the decomposition of the sulphate of iron by the gallic acid. Into a wine glass, containing the infusion of galls, pour a solution of the sulphate of iron. The gallic acid, from its superior elective affinity to the iron, detaches it from its former combination with the sulphuric acid, and in a short time, these two fluids previously colourless, become intensely black. To make this black fluid into ink, nothing but a little gum is required to retard the precipitation of the feculae.

Experiments on Human Hair.—M. Vauguelin, the celebrated French chemist, discovered from some experiments which he made, that black hair is formed of nine different substances, viz. animal matter, a white concrete oil, another greenish grey, one which is very abundant, iron, some particles of oxide of manganese, a phosphate of lime, carbonate of lime, silex, and a considerable quantity of sulphur. Red hair contains red oil in place of a greenish black kind, and white, or very light hair, differs from all the others, as the oil is nearly colourless, and it contains some phosphate of magnesia, which is not found in the others.

Theory of Dyeing.—The preceding account of the experiments of M. Vauguelin on the construction and colour of human hair, leads us to notice that the colour of dyed stuffs, silk, cotton, or woollen, is owing, also, to the reflection of the colouring matter contained in their transparent tubes. The fibres of these materials are found to be minute tubes, containing peculiar liquids, mostly of an oily nature. This oily, or other matter, is extracted in the preparatory processes of dyeing, by the use of alkalies and acids; or it is converted, by the different mordants employed, into other substances, better adapted to the contact of the colouring matter, which is afterwards introduced into the tubes in the dye bath.

Congelation of Mercury.—M. Gay

Lussac states, in a Memoir on the Cold produced by the Evaporation of Fluids, that he has readily frozen Mercury, by surrounding it with a frigorific mixture of ice and salt, in the apparatus in which aqueous vapour is produced by the process of Mr. Leslie; and he has no doubt, with analagous means and very vapourable liquids, a degree of cold might be produced below that caused by mixtures.

Purification of Rooms, Ships, Hospitals.—Into a quantity of common vinegar, throw in powdered whiting or chalk until it ceases to bubble by the extrication of carbonic acid gas. Allow it to remain until the white powder has subsided, when the supernatent liquor is to be poured off. The white powder is then to be dried and put into a vessel of stone or glass, and sulphuric acid poured upon it as long as the white acid fumes continue to arise. The fumes if condensed into a liquid state would form the acetic acid, or aromatic vinegar of shops. The facility and cheapness of this process renders it peculiarly useful for the purification of hospitals, ships, prisons, and houses, or wherever contagion may be suspected, as the fumes are very quickly diffused into every part.

It is said that our rectifiers imitate the flavour of brandy by adding a small proportion of nitrous either to the spirit of malt or mollasses.

Permanent Ink for Writing on Linen.—Moisten the cloth with a liquid formed by dissolving one ounce of salt of tartar in two ounces of water, and write with a composition made by dissolving one dram of lunar caustic in two drams of the infusion of galls.

Paper Tree of Japan.—From the bark of the young shoots of this tree the ingenious natives of Japan, manufacture their beautiful glossy paper. By boiling the sticks in water, which occasions them to shrink, the bark is separated from the wood. To make it into paper it is first cleansed from all impurities, then boiled in a clear ley, constantly stirring it, till it becomes so tender that on being touched it easily separates into small fibres. It is afterwards well washed, diluted, and worked about till it becomes of a uniform soft, delicate, woolly substance, and then beaten with sticks till it resembles the pulp of soaked paper. It is then mixed intimately with the gelatinous mucilage of rice and the oreni root, which renders the mixture fit for forming into leaves of paper: to effect this, they make use of moulds made from bulrushes, and the subsequent operations are so similar in principle to our own, that we consider it unnecessary to detail them. This Paper Tree, is the Moras Papyrefera of Linnæus—a species of the mulberry.

Mildewed Hay and Corn may be recovered and rendered sweet and agreeable to cattle by the use of common salt. The late Mr. Arthur Young recommends the salt to be used in the proportion of one peck to a load of hay, which is to be strewed upon the hay, in layers, as it is unpacked from the stack. Horses, as well as other cattle, will eat greedily damaged hay that has been salted, which they will not touch without the salt. A solution of common salt sprinkled on corn affected with mildew will completely remove the disease.

New Solar Theory.—Dr. Hoyer, of Minden, has published in the Sunday Journal of that town, a detailed account of his hypothesis, that the Nucleus of of the Sun consists of molten gold.

NOTICES TO CORRESPONDENTS.

"A. Saltcoats," should send us an account of his invention. It would be of little use inserting his communication without this.—"L. M'L's," proposal of attaching bells to carriage horses has been tried, we believe, with some success in England. Bigotry and prejudice protest aginst its being adopted by Scotchmen.—We will with great pleasure, insert Mr. Ruthven's communication. We have often regretted the want of such an Institution, and doubt not it will be highly useful.

Published every Saturday, by W. R. M'Phun, 86, Trongate, Glasgow, to whom Communications (post paid) must be addressed.

AITKEN, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE,

CONDUCTED BY

A Committee of Civil Engineers and Practical Mechanics.

> " These are the gifts of Art, and Art thrives most
> Where commerce has enrich'd the busy coast;
> He catches all improvements in his flight,
> Spreads foreign wonders in his country's sight,
> Imports what others have invented well,
> And stirs his own to match them, or excel.
> 'Tis thus reciprocating, each with each,
> Alternately the nations learn and teach;
> While Providence enjoins to ev'ry soul
> A union with the vast terraqueous whole."—*Cowper.*

No. CXLII. *Saturday, 9th September,* 1826. Price 3d.

GLASGOW MECHANICS' INSTITUTION.

IT is with feelings of pleasure, that we announce the election of Mr. Thomas Clark, as Lecturer on Mechanics and Chemistry to the above Institution, on the 4th current. Nothing could augur better the future success of this Institution than this election. Whenever common sense and generosity of feeling get the mastery over the rage for quack Lecturers, and novelty from a-far, over the petty rivalry of individuals born in the same city, and the natural feeling of inferiority at the rising merit of a young townsman, then there is great reason to congratulate the age on the increased liberality produced by such useful Institutions. We take no small credit to ourselves for having had a share in this highly commendable change in the management of this Institution. On a former occasion we ridiculed, in terms of the most unmeasured description, the folly of electing persons having endless testimonials and untranslateable titles, pretending that they were somebody, when they were nobody, and giving themselves out for scientific characters, while they were ignorant of the first principles of Science; our triumph is now complete;—the very man we formerly recommended has, at last, been elected although, we regret to state, it has been after sad experience has taught the Institution that its best interests are the same with that of the rising *genii loci,* and are not to be rendered *homogeneous* with that of foreigners. Of the abilities of the present Lecturer we shall not say one word, save that we are confident all his attention and talents will be exclusively devoted to the advancement of the Institution in knowledge, in science and in renown, and that considering his future fame, as well as the fame of the Institution, are identified with these objects, he will leave no scheme untried to render himself and it immortal.

CONSERVATORY FOR MODELS OF MECHANICAL INVENTIONS.

An Establishment for purchasing Models, Drawings, &c. of Mechanical Inventions, has long been contemplated, by a number of Gentlemen in this city, as an object deserving attention, and at their desire, J. Ruthven, Patent-Press Manufacturer, is now making arrangements for that purpose.

It is intended either to purchase such Models, &c. as may be considered useful or ingenious, or receive them for public inspection, with the Inventor's name, &c. attached.

From the arrangements that are making, it is expected that considerable advantages may be derived to many ingenious individuals, by bringing forward and giving publicity to their inventions, as descriptions of them, with Engravings, will be occasionally published.

After a sufficient number of Models are obtained, farther particulars will be advertised; it is therefore requested, that those who wish to patronize this undertaking, will contribute such Models, &c. as they may have, and of which the greatest care will be taken, if not purchased.

Communications with Models, Drawings, &c. addressed to John Ruthven, 23, New Street, Canongate, will receive every attention.

Edinburgh, August, 1826.

REVIEW:—THE UNIVERSAL GAZATTEER.*

To Mr. Joseph Miller's name most of our readers have already been introduced, by his able "History of Great Britain during the Reign of George the Third," and we have no hesitation in saying, a still larger portion of them will become familiarised with it through the medium of this his *Universal Gazetteer*. It is one of that class of publications which is more likely to attract the attention of the important class of Society for which we expend our labours. It is a much more *useful* work; and from the more convenient way in which it is *publishing*, as well as from the respectable manner in which it is got up, we do not doubt it will become popular. The illustrative Maps and Plates are elegantly engraved on Steel, and would not discredit the much more expensive and pretending contemporaneous works now appearing.

The importance of bringing forward this new Gazetteer, at present, no one will venture to call in question. Many events and circumstances concur to shew the necessity of producing a universal, yet succinct Alphabetical Geography, one to which men of business may refer with security for information upon the local and relative situations and importance of places throughout the surface of the Globe.

New divisions and appropriations of territories, new governments and states, increased population and production, extended and accelerated commerce, and settlements formed in remote countries by enterprising associations, make it necessary to provide the public with an index to the present divisions and remarkable places of the earth, and especially to the present state of those countries whose inhabitants are attaining to freedom, commerce, opulence, knowledge, and power.

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* The Universal Gazetteer, and Alphabetical Geography: Describing the Natural and Political Division and Remarkable Places on the Surface of the Globe; and containing a Geographical Nomenclature more copious than any yet extant; interspersed with authentic Notices of the Inhabitants, Climates, Soils, Productions, Manufactures, Commerce, Institutions, Population, and other Topics of Local Information, indicative of the Present State of the Earth. Compiled from the best Modern Authorities, by Joseph Miller, Author of a *History of Great Britain* during the Reign of George the Third, &c. Illustrated by Maps, *and Engravngs*, in weekly Number.—London: G. Virtue.

The extensive military and naval operations of the late wars, and the spirit of discovery, and of naval survey, that has been prevalent since they ceased, have contributed largely to the public stock of information upon geographical and topographical subjects. But the activity and researches of philosophical land travellers, since peace freed them from restraints and impediments, have excelled, in copiousness of observation upon those topics, even the liberal contributions of professional writers.

From these causes, the catalogue of geographical and topographical names, and other particulars, has changed and increased so much, that all former Gazetteers which contain a partial selection of places are become obsolete and of little use. Mr. Miller has, therefore, undertaken the arduous task of filling the present chasm in this class of publications, with a work which unites to a geographical nomenclature, more copious than any yet extant, authentic notices of the situations of places and, in many instances, of the hydrography of seaports; also, descriptive particulars of the natural and present circumstances of each country or territory, with leading facts, indicative of the present state of capital cities and principal towns, and of their inhabitants: the agregate number of the population, at a recent period, being specified, where attainable, because it is the best criterion of local prosperity or decline.

The limited number and bulk of the books of reference admissible into a counting-house, and the purposes for which they are consulted, do not permit that any such work should be voluminous, or require that it should dilate upon the historical, chronological, ecclesiastical, political, geological, and statistical details of countries and remarkable places. The author has, therefore, we conceive very judiciously condensed, into one volume, the information that is necessary to aid correspondence and intercourse, without attempting to supersede those voluminous works which professedly treat of the extensive subjects that are philosophically connected with modern geography, and are not so much adapted to the occasions of the man of business, and the man of Science.

TANNING.

TANNING is the art of manufacturing leather, a substance applicable to numerous important purposes, for which the untanned skin or hide is altogether unsuitable.

Introduction.—The essential process of this art, is the combination of the vegetable principle called *tannin*, with the gelatine or glue, which constitutes the greater proportion of the matter of skin. Tannin and animal gelatine combine with much facility, forming, from a state of solution, a soft flocculent precipitate, which, on drying, becomes hard and brittle. The tannin of different vegetables combines with different proportions of gelatine. The combination is influenced too with regard to the relative quantities that combine by the concentration of the solution of gelatine, the quantity of precipitate being greatest when the solutions are mixed in a concentrated state: and also by the quantity in which one is added to the other—an excess of gelatine re-dissolving part of the precipitate, or rather forming with the tannin a more soluble compound. The skin of an animal, when freed from the hair, epidermis, and cellular substance, consists principally of indurated gelatine. By immersion in the tan liquor, which is an infusion of oak bark, or other powerful astringents, the combination of the tannin with the organized gelatine, which forms the animal fibre, is slowly established, and the compound of tannin and gelatine not being soluble in water, and not liable to putrefaction, the skin is rendered dense and impermeable, and not subject to the spontaneous change which it would otherwise soon undergo. To render it equal throughout the whole substance of the skin, the action of the tan liquor must be gradual, and hence the tanning is performed by successive immersions of the skin in liquors of different strength. A portion of the extractive matter of the infusion appears also to enter into the combination. The skin increases in weight from one-fifth to one-third.

History.—It is extremely probable that this art derived its origin from the accidental immersion of the skin of an animal in a vegetable infusion, containing a portion of the astringent principle or tannin. Experience soon demonstrated that skins, prepared with certain vegetable substances, especially the bark of oak, acquired new properties; that, without losing their flexibility, they became less pervious to water; more firm, more compact, and in some measure, incapable of putrefaction. Tanning is one of the most ancient of the arts, is known among all nations, and is remarkable for the similiarity of the methods by which it is practised. It comprehends a succession of processes, which, at an early period of society, were executed by habit and imitation, without a knowledge of the essential principles. Accordingly, the preparation of skins required several years; and frequently, in spite of the care, expense, and slowness of the operation, the tanning was incomplete; the skin formed a soft and porous leather, which was soon destroyed by moisture. These defects essentially sprung from ignorance of the true principles of this operation, because no discovery had been made respecting the action of tan upon hides and skins, and the circumstances or conditions which might accelerate or retard the process.

The leather consists of three sorts, namely, butts or backs, hides, and skins. Butts are commonly made from the stoutest and heaviest ox-hides, and are principally used for the soles of stout shoes. The leather which is known by the name of hides, is usually made from cow-hides, or the lighter ox-hides, and is used for the lighter soles of shoes. Skins is the general term for the skins of calves, seals, hogs, and dogs, which, after being prepared, dressed, and blacked, are used for the upper leathers of shoes and boots. The lighter sorts of hides, called dressing hides, as well as horse hides, are used for coach-work and harness work.

Processes of the art.—Skins or hides, before they can be converted into leather, require to be freed from those matters which are not soluble in water, and which are consequently not only incapable of forming a compound with tan, but are injurious in preventing its perfect combination with the gelatine of the true skin. Before the process of tanning can be completed, certain preliminary operations are therefore necessary.

The mode of conducting the preliminary operations is regulated according to the nature of the skin to be tanned. Ox-hides, in a raw or green state, are first carefully cleaned in water, to separate the blood and other impurities, and are then left for some time to soak in the same liquid ; but if the hides be dry, the steeping must be continued for a longer time, according to the heat of the season. The hides are drawn out once or twice during the time of steeping, in order to see if they are sufficiently softened for the next operation ; and some manufacturers, after cleaning the hides in water, roll them up in heaps, and put them into a warm place, to promote the putrefactive process, that the hair and cuticle may be more easily scraped off. The hides are then put into pits sunk in the ground, and lined with stone or brick along with slaked lime, to which a quantity of water is added to bring it to the state of cream of lime. There are usually three kinds of pits, according to the strength of the lime. The hides are first immersed in the weakest solution, and are allowed to remain till the hair readily yields to the touch ; and, if this mixture be not sufficiently active, they are removed to the next pit, containing in the mixture a larger proportion of lime. The time of steeping is regulated according to the nature of the hides themselves, the temperature of the air, and the strength of the mixture. *As a substitute for the* cream of lime lime-water has been proposed. Its action, however, seems not to be sufficiently permanent, and, besides, the solution requires occasionally to be renewed. Some tanners steep the hides for a short time in the pits, then pile them up in a heap on the ground for eight days, after which they return them into the same pits ; and then repeat the same alternate operations till it appear that the hair can be easily scraped off. It is the practice in some countries, to mix a large quantity of ashes with the lime, because lime alone is generally supposed to be injurious to the leather. Though the application of lime is very old, and is understood to be still a very general practice, some are of opinion that lime, when retained in the skin, renders it hard and brittle, and especially when it is employed in this preliminary process. As the lime is not easily washed out from thick hides, perhaps the best method of freeing the hides from the hair and other extraneous matters, is to steep them in water, and subject them to incipient fermentation. The hair, as well as the scarf skin and impurities that collect on the hide, are scraped off by spreading it on a sort of wooden horse or beam, and scraping it with a crooked knife.

The hide is now to be subjected to the process of *raising*, which is designed to qualify it for receiving the tan liquor. In order to open the pores, it is immersed in a liquor formed from the fermentation of rye or barley flour, which appears to have a powerful effect in opening or raising the texture of the skin : this effect, however, is perhaps assisted by the fermentation induced or continued on the skin itself. Considerable attention in the conducting of this process is required, that the texture of the hide may not be weakened or destroyed by too long exposure to the action of the acid. A good deal of uncertainty in the process of softening and raising hides is occasioned by the variable strength of the acid solution, the state of the weather, which tends to retard or accelerate the fermentation, and other external causes which are not easily appreciated. With the view of obviating these inconveniences, the use of very diluted sulphuric acid is recommended. The proportion of the acid employed is about a wine pint of common vitriol to 50 gallons of water. The fermentation of the hides continues in the bath of the vegetable acid, and when the process is properly conducted, renders them thick and soft; but in the vitriolic bath, the fermentation is interrupted, the skin is less apt to be injured by long immersion, and it comes out thick and hard. The process of raising hides, by means of acid composition, is accelerated by employing the acid warm, as well as by the method of removing the hides from a weaker to a stronger liquor, till they are sufficiently raised and softened.

In preparing the skins of cows and calves, and such as are to be converted into the more flexible kinds of leather, the hide, after being soaked for a day or two in water, to free it from the impurities, is placed on the beam to separate the adhering fat or flesh: it is then kept several days in a pit with lime-water and frequently stirred, for the purpose of loosening the hair and cuticle, which are removed with a blunt knife while the hide is again stretched on the beam. A bath is next prepared of water, and the excrementitious matter of domestic fowls, sea-fowls, pigeons, or dogs, which are *selected* on account of their *putrescible qualities,* and are diffused in water. The hide, with this liquid, is thrown into a pit, denominated the *mastering pit,* where it is kept for a longer or shorter time, according to the density of its texture, and, being hard and thick before immersion, is taken out in a soft and pliant condition. A great deal of precaution is necessary in conducting this part of the process with thin and fine skins, because, should it be continued only a few hours beyond the proper time, the texture of the skin will be destroyed. The hide is afterwards cleaned on the beam, and rendered fit for receiving the tan.

For the *process of tanning,* all vegetable matters, containing the astringent principle, are suitable: but larch and oak bark are generally employed in this country, as they contain a large proportion of the necessary ingredient, and are to be had in great abundance. The bark being stripped off from timber felled in the spring, is piled up in large stacks, which are protected by a covering from the rain, but are exposed at the sides to a free circulation of air. After the bark is dried, it is ground in a mill, and mixed in the pits with water. The infusion thus formed is technically called *ooze*, and, besides, the tannin consists of the other soluble parts of the bark.

The prepared hides are first introduced into pits with a very weak ooze, in which they macerate for some weeks, during which they are frequently *stirred,* or, as the workmen say, *handled.* The strength of the different oozes is gradually increased, and the half-tanned hides, if they are intended for the thicker kind of leather, are arranged in larger pits with alternate layers of ground bark till the pit is filled, and over the whole is placed a layer of bark, while the interstices are filled up to the brim with a weak ooze. The hides are in this way exposed to the full action of a saturated solution of tan, and are supplied with additional portions of the bark in substance, as they absorb what is dissolved, till the process is supposed to be completed. A white streak is perceived in the middle when the process is not completed, but as far as the tan has thoroughly penetrated the colour is of a nutmeg brown. The hide, after being tanned is removed from the pit, allowed to drain, and is stretched on a convex piece of wood, called a horse, on which it is beaten with a heavy steal pin for the purpose of smoothing it completely, and it is also sometimes placed between iron cylinders with the view of rendering it as solid and pliant as possible. It is afterwards removed to the drying house, where it remains till it is thoroughly dried by means of a free circulation of air which is admitted through openings in the sides of the building.

To a certain extent, the longer that leather is allowed to remain in the ooze, it gains in weight and also improves in quality. Common calves skins are sufficiently tanned by being subjected to the process from two to four months; but the thick hides of which sole leather is made, require 15 or 18, and in some cases even 20 months.

As oak bark contains the soluble matters, besides the tan, as gallic acid and extract, both of which are absorbed by the skin, they must be considered as forming a part of tanned leather. The blackness induced by rubbing the leather with a solution of any of the salts of iron, is a proof that the gallic acid enters into the composition of the tanned leather, when the process is conducted in the ordinary way. The brown colour, as well as some degree of flexibility, is perhaps communicated to the leather by means of the extract, and it is supposed that the proportion of tan absorbed, is, in a great measure, regulated by the quantity of extract in the infusion. The quality of the leather is also affected by the strength of the tanning infusion and the weight that the skin acquires during the process. As tan is more soluble than extract, a solution, containing a large portion of the materials, is nearly saturated with the tan, while the proportion of extract is comparatively small. Skin appears to have the power of fixing a larger quantity of tan than of any other ingredient in the infusion, and particularly of extract, so that, if it be nearly saturated with extract, it will absorb less tan than before, and the entire increase of weight will be much less in this way than with tan alone. Leather composed of skin and tan, with only a small proportion of the other ingredients, is more brittle and less durable when it absorbs a larger portion of extract. Perhaps, too, the quality of the leather is affected by the duration of the process, where the same infusion is employed in a more or less diluted state; for, when the process proceeds rapidly, the outer part of the skin may be strongly tanned before the inner part be penetrated with the liquor, and the closeness of texture thus produced may prevent the access of the particles of tan to the internal parts of the skin, and preclude the requisite uniformity through the whole substance of the leather. A greater proportion of tan is absorbed by rapid than by slow tanning. For example, 100 parts of leather, prepared in two weeks, were ascertained to be composed of 73 of skin, and 27 of tan, and other substances absorbed from the infusion of oak bark, and the same quantity of leather prepared in 12 weeks, in an infusion proportionably weaker, contained 85 parts of skin and only 15 parts of tan, and the other soluble ingredients.

M. Seguin, a French manufacturer to a great extent, in order to abridge the time, and diminish the expense occurred in the common process of tanning, proposed to employ solutions of tan instead of the compound mixture obtained from the infusion of oak bark of different and known degrees of strength, through which the skin might be gradually and regularly passed from the weaker to the stronger solution. Having arranged a series of vats, with a quantity of oak bark in each, he poured water into the first, and drew it off clear from a hole in the bottom. This infusion was poured on the back of the second vat, drawn off, poured on the third, and lastly on the fourth, or the whole series of vats, till it was saturated with tan. He then poured fresh water on the bark of the different vats in the same order, and a second ooze, inferior to the first in strength, was obtained. Three or four different infusions, varying in strength, were prepared in the same manner, and these constituted the tanning liquor which was to be employed according to the new process. After the necessary preparations, the skins were past successively through the different infusions, from the weakest to the strongest, till the tanning process was accomplished.

This method, though calculated to abridge the time of the tanning process, has not been generally adopted by the manufacturers in this country, owing, perhaps, to the leather produced being of an inferior quality. Indeed, the main objection to the new method seems to be the want of the same vegetable matters of the bark which are dissolved in the water by the old process. In the infusion prepared by the French manufacturer alluded to, the tan is in larger proportion, and the extract in smaller proportion, and to the deficiency of the latter may be ascribed the brittleness and inferiority of the leather thus tanned. A saving of time might be effected by employing some of the oozes warm, for, in this way, the skins are sooner penetrated with the tanning principle.

Currying.—The operations of currying are necessary to render leather applicable to many purposes. The tanned hides, as in the case of calf-skins, are first brought to a somewhat regular shape, by cutting off the offal parts, and then softened, partly by soaking in water, and partly by mechanical means. The wet skin is next thrown over the beam, with the flesh side outwards, and the leather is reduced to a uniform thickness by means of a double edged knife, of a peculiar construction, which is applied horizontally. It is afterwards thrown into water, to be scoured and extended, and, for this purpose, it is laid on a stone table and worked well with the edge of a small square stone, fixed in a handle, and with a brush it is cleansed from a whitish substance which appears on all leather tanned with bark. The extending of the skin causes the natural folds to disappear, for which purpose it is sometimes scoured a second time. The hide is at length removed to the drying shed, where a mixture of cod-oil and tallow is applied to both sides of it, but in greater proportion to the flesh than to the grain side. When leather is lightly *stuffed*, as this operation is called, it is less durable than when it is rendered soft and flexible with the mixture, and if it be impregnated with too much of the oil and tallow, the colour of the grain is injured. It is usual to dry the hide under a shed or in a stove.

The next operation to which the skin is subjected, is *boarding* or *bruising*. For this purpose the skin is doubled, and worked with a coarse groove till it is well softened, and is again lightly shaved, which leaves the flesh side clean, and, after a second boarding, it is said to be *finished russet*.

The blackning which is termed *colour*, and is composed of oil, lamp black, and tallow, is well rubbed with a hard brush into the flesh side, while the grain side is rubbed with a solution of copperas, or other iron liquor.

The preparation of leather for gloves, coach-linnings, pocket-books, and book-binding, some of which is known by the name of Morocco leather, is varied according to the nature of the material employed.

When the leather is to be preserved white, it is finished by the operation of *tawing*, which is conducted in the following manner:—Lambs' skins are first soaked in water, to separate the blood and loose impurities, and being placed on the beam, and scraped on the flesh side with a blunt semicircular knife, they are hung up in a small close room, heated by flues. During the putrefactive process, which is promoted by the heat, a slimy matter exudes from the surface; the wool is loosened and readily comes off, and the slimy matter is worked off with the knife. To check the putrefaction the skin is steeped in lime-water from two to six weeks, according to its nature. During this process it *increases in hardness* and thickness, and being again worked on the beam, is pared to an equal and uniform thickness, and smoothed with the knife; and, to free it from the lime, it is kept for some weeks in a mixture of bran and water, in which it undergoes a slight fermentation, and the thickness diminishes by the separation of the lime. In this purified state it is called *pelt*, and is fit for tawing, dying, or any other operation for which it is intended. In the same way kid and goats' skins are brought to the state of pelt, with this difference, that the liming process is employed before the hair is taken off. The pelt, thus prepared, is immersed in a solution of alum and salt, in warm water, in the proportion of three pounds of alum, and five pounds of salt, to 120 middle sized skins; and, being worked about in this solution, it acquires a great degree of toughness and thickness. The skins are then washed in water, and for some time fermented in bran and water, by which the saline matter is separated, and the thickness reduced: stretched on hooks in an apartment furnished with a stove; and, when fully dried, are converted into a tough, flexible, white leather. To give the surface a glossy smoothness, the skins are again steeped in water, and then trodden with the feet in a large pail, with the yolks of eggs beaten up with water, till they absorb the substance of the egg, and the water becomes transparent. They are then dried and smoothed over with a warm iron. In one point the process of tawing is analogous to tanning; for the change produced gives greater strength and tenacity to the skin, and renders it capable of resisting putrefaction. This change is supposed to depend on the absorption of the base of the alum, or the alumina, from which it seems never to be entirely freed in any subsequent operation.

The leather employed for coach-linings, pocket-books, and other purposes, called Morocco leather, is chiefly made from sheep skins. After the previous preparations, already detailed, and when the skins are taken from the lime-water, they are immersed in a bath of the dung of dogs or pigeons in water, and remain till the lime is separated, and they are converted into a clean white pelt. If the skins be intended for black leather, they are introduced into a vat with sumach and warm water, and, by means of a stiff brush, are rubbed over with an iron liquor. But if they are to be dyed red, they are sewed up very tight, in the form of a sack, with the grain side outwards, which only is to receive the colour, and then immersed in a bath of cochineal, of such a temperature as the hand can easily bear, and are worked about in the usual way till they are uniformly dyed. After this process, for the success of which much skill and experience are requisite, the sack is introduced into a bath of sumach, where it is kept several hours, till it be sufficiently tanned. It is then finished with a weak bath of saffron, to improve the colour. The last operations to which this kind of leather is subjected, are polishing and graining. Being stretched tight on a smooth inclined board, the skin is first smeared over with a little oil, to render it flexible and pliant, and then polished by the hand with a glass ball having a polygonal surface. A great deal of labour is required in this operation, which renders the skin compact and firm. The graining or inequality of surface is produced by rubbing the leather strongly with a ball of box-wood, round the centre of which small parallel grooves are cut in at equal distances.

Morocco Leather, which derives its name from the method of preparing it, having, as is supposed, originated in the kingdom of Morocco, consists of the skins of goats, dressed in a particular manner, and dyed at pleasure. The skins are cleansed, the hair removed, and limed; being reduced in a bath of bran, and water, they are immersed, for four or five days, in a second bath of white figs and water; and after being salted with rock salt, they are ready for receiving the dye. Cochineal and alum are employed to communicate a red, and pomegranate bark and alum a yellow colour. The skins are then tanned, dressed, and finished with oil and dried.

A peculiar kind of Morocco leather is mauufactured in some of the southren provinces of the Russian empire, and particularly at Astrachan. The skins of bucks and goats only are employed for this kind of leather, and it is usually dyed red or yellow. The preliminary preparations are similar to those which have been already described for purifying the skin, and bringing it to the state of pelt. But, after the branning, a portion of a liquid composed of honey dissolved in water, is poured on each skin spread out on a wooden tray, and when the whole of the honey is absorbed, and the fermentation of the skin has continued for about three days, it is salted in a strong brine, and when dried, it is fit for receiving the dye. The red is communicated with cochineal and an alkaline plant, a species of *salsola*, which is abundant in the deserts of Tartary. The colour is then finished with alum, and when the dyeing process is completed, the skins are tanned with sumach. For the finer reds, a quantity of sorrel is added to the cochineal bath, and the tanning process is completed with galls instead of sumach, and thus a more durable colour is obtained. The roughness on the surface of this leather is produced by an iron rake with blunt points, and of considerable weight. The yellow colour is given with the berries of a species of rhamnus, or with the flowers of wild camomile.

Russia leather, which is distinguished by its durable quality and peculiar smell, is prepared by steeping the hides in a weak alkaline ley, scraping them on the beam, and, if calves' skins are employed, by reducing them with dogs' dung, and a sour drench of oat meal, when they are ready for tanning. This process is conducted with great care, and, during its progress, the hides are often subjected to the operation of handling. The bark of the black willow, or that of birch, is preferred to oak bark for tanning this kind of leather. When a red colour is to be communicated to the hide; it is steeped in alum, and dyed with brazil wood: and black is given with an iron liquor. The peculiar smell of Russia leather is derived from birch tar, with which it is smeared, and being thus secured from the attacks of worms, is much esteemed for book-binding. A heavy steal cylinder, round which wires are wound, is employed to give the streaked or barred surface.—*See Aikin's Dictionary of Chemistry.*

REMARKS BY MR. EVE ON THE SUPERIORITY OF HIS ENGINE TO ANY PRECEDING INVENTION.

WATT's low pressure, and Evan's high pressure steam-engines, have been brought to such perfection as to leave nothing further to be wished for as regards their efficacy and durability, or their general appropriation to most purposes where power is required. There are, however, several desiderata still remaining that are necessary to render the steam-engine the universal mechanical agent in some of the most important objects. These are principally as follows:—

1. An exemption from the dangers of accidents.
2. A reduction in the expenditure of fuel.
3. A reduced expense in their erection.
4. A diminution in the weight and magnitude of the engine.
5. Simplicity in construction.

In constructing the steam-engine specified above, an attempt has been made in some degree to attain those objects. It is presumed, in the first place, that from a steam generator so small as the above-described, containing little water and steam, with the provision made in its construction against any danger, even were a rupture to take place, no danger could possibly happen to persons near the engine.

It is obvious, that the quantity of fuel consumed will bear a proportion to the boiler or steam generator, and that, comparatively, very little can be consumed in so small a furnace as my steam generator requires. The simplicity of the principle of this engine, in all its details, is sufficiently apparant on referring to the specification.

There are no reciprocating parts, levers, fly-wheels, or valves, but simply two revolving parts; and, if

I may so speak, the whole power of the steam is appropriated by the direct or first intention. The relative weight and bulk of this engine will require a few more words for elucidation. A more concentrated power in steam-engines is attainable in two ways:—the first is by using steam of great elasticity; thus, on Mr. Perkins's plan, a cylinder, two inches in diameter, would be sufficient for a ten-horse power. The second method of diminishing the dimensions of steam-engines is, to increase their mobility; that is, to give greater velocity to the part or parts on which the steam acts. This, in all engines having reciprocating motions, is limited; for motion, alternately in opposite directions, requires a certain time, otherwise the whole power of the engine may be consumed by simply overcoming the inertia. Now it is certain, abstractedly considered, that as we increase the velocity of the piston, we may decrease the size of the engine; it follows, therefore, from the above premises, that if we could conveniently make use of steam of 150 lb. to the inch, instead of mere atmospheric pressure, and have 150 strokes to the same engine instead of 15, we should acquire 100 times the power; or, what is the object at issue, have the same power with an engine and generator in that proportion smaller.

The first object, as regards high pressure, it will not be too much to concede, as it has been long ago practically attained by Evans, and others. And, as to the velocity which this engine is calculated to admit of from its construction, though not unlimited, it is certainly very great, much more then ten times that of reciprocating engines, and much greater even than that of *rotatory* engines, that have reciprocating parts. Thus, if these premises be correct, it cannot be too much to say that this engine ought to have the same power as the engines in common use, though of smaller dimensions; and that the weight will be reduced, not in proportion to the reduction of its superficial, but its cubic dimensions.

The simplicity of the engine (the next desideratum,) I conceive, cannot be well increased, as the engine itself consists of but two revolving parts. And lastly, as a result, the expense of erecting an engine of a given power, on the construction of the above, ought to bear a proportion to the diminution of its bulk and weight, and greater simplicity.

The difficult of availing ourselves of the advantage of using steam twice, that is, first as high pressure, and then in a condensing engine to any extent, is sufficiently apparent from the following considerations:—It appears from Mr. Woolf's experiments, that steam, heated to balance 6 lb. to the inch, will expand into 6 times the volume under atmospheric pressure; at 20 lb. to 20 times; at 40 lb. to 40 times; and so on. Working with comparatively so low a pressure as 40 lb. to the inch, it would be found extremely inconvenient to use two engines whose capacities were as one to forty; and if not impossible, would appear ridiculous, if steam of 200 lb. elasticity (which is quite common in the United States) be used, as the second engine would have to be 200 times the capacity of the first, which in this extreme case would at least have a disproportionate appearance. All reciprocating engines, or those having reciprocating parts, will have to contend with this inconvenience; or, rather, can only avail themselves of a partial advantage from using high and low steam, as they have to work stroke for stroke. With my rotatory steam-engine the full benefit of this principle may be appropriated, as the engine that acts by high pressure may be made to revolve as much faster than the first as to allow of the full expansion of the steam before it is acted on, for the velocity may be carried to any extent required, without inconvenience.

It is presumed that it will not be too much to say, from what has been known to be done by using steam twice, on Mr. Woolf's principle, even with the reciprocating engines, that a saving of half the fuel may be achieved when applied to my rotatory engine, which is so much better adapted to give it full effect; nor ought it to be considered extravagant to anticipate that a moiety of the balance will ultimately be saved by some of the new modes of generating steam, which the ingenuity of so many competitors has elicited, among whom I have ventured to enter the lists.

If the seal of experience should testify to the truth of these anticipations, steam navigation over the great deep, and the general adoption of locomotive carriages, may not be considered, as at present, the dreams of a visionary.

MISCELLANIES.

Mr. Scoresby's valuable observations on the effects of the sea, at great depths in augmenting the specific gravity of different woods were elicited by a circumstance as singular as it is interesting.

My father, he says, met with the singular instance in the year 1794, which I have taken from his log-book.

On the 31st of May, the chief mate of the Henrietta struck a whale, which "ran," all the lines out of the boat before assistance arrived, and then dragged the boat under water, the men meanwhile escaping to a piece of ice. When the fish returned to the surface to "blow," it was struck a second time, and soon afterwards killed. The moment it expired it began to sink, which not being a usual circumstance excited some surprise. My father, who was himself assisting at the capture, observing the circumstance, seized a grapnell, fastened a rope to it, threw it over the tail of the fish, and fortunately hooked it. It continued to sink; but the line being held fast in the boat at length stopped it, though not till the "strain" was such that the boat was in danger of sinking. The "bight," or loop of a rope, being then passed round the fish, and allowed to drop below it, inclosed the line belonging to the sunken boat, which was found to be the cause of the phenomenon observed. Immediately the harpoon slipped out of the whale, and was, with the line and boat attached to it on the point of being lost, when it was luckily caught by the encompassing rope. The fish being then relieved from the weight of the lines and boat, rose to the surface, and the strain was transferred to the boat connected with the disengaged harpoon. My father, imagining that the sunken boat was entangled among the rocks at the bottom of the sea, and that the action of a current on the line produced the extraordinary stress, produced himself to assist in hauling up the boat. The strain upon the line he estimated at not less than three-fourths of a ton, the utmost power of twenty-five men being requisite to overcome the weight. The laborious operation of hauling the line in, occupied several hours; the weight continuing nearly the same throughout. The sunken boat which before the accident would have been buoyant, though full of water, when it came to the surface required a boat at each end to keep it from sinking. "When it was hoisted into the ship the paint came off the wood in large sheets; and the planks which were of wainscoat, were so completely soaked in every pore, as if they had lain at the bottom of the sea since the Flood." The boat was rendered useless; even the wood of which it was built, on being offered to the cook, as fuel, was tried and rejected as incombustible!

Moss.—The humble and apparently insignificant Moss is an active agent in some of the most important changes of nature. By its great absorption of moisture, its decay and subsequent revival in succession, the hardest rock, upon which not even a blade of grass could grow, becomes covered in the course of years with a stratum of fertile soil, supporting the most luxuriant trees. At first a little dust is blown into the interstices of the rock, into which are also driven by the winds some of the seeds of the Moss from a less sterile spot. Here they vegetate, and the hitherto naked rock becomes covered with pretty green tufts; which spreading wider and wider year after year, its whole surface is at length covered with the smiling carpet of Nature. The continual growth and decay of the Moss and other small plants, gradually increase the thickness of the stratum, larger plants, the seeds of which are borne from all quarters by the weather; the rotting of these plants continue to add to the soil, till at last are seen to flourish the noblest trees of the forest. Thus, the hard and barren rock is made to abound in the richest products and the grandest vegetation: and thus are the sandy heaths and desert plains converted into verdant and fruitful fields. On the tops of the highest hills and mountains the Mosses attract the moisture from the clouds, which trickling through every crevice to find its way to the lowest place, accumulate and form cascades and brooks, which again uniting, swell into the largest rivers. These waters flowing into the sea are again raised by the influence of the sun's rays, and form clouds, again to be employed in fertilizing and refreshing the earth. Such is the admirable and unceasing process of Nature!

African Mode of Cooking an Ostrich's Egg.—A small hole, the size of a finger, is very dexterously made, and having cut a forked stick from the bushes, they introduce it into the egg, by pressing the two prongs close together; then by twirling the ends of the stick, between the palms of the hands, for a short time, they completely mix the yolk and the white; setting it upon the fire, they continue frequently to turn the stick, until the inside has acquired the proper consistence of a boiled egg. This method recommends itself to a traveller by its expedition, cleanliness, and simplicity; and by requiring neither pot nor water; the shell answering perfectly the purpose of the first, and the liquid nature of its contents that of the other. Notwithstanding the enormous size of one of these eggs, being fully equal to twenty-four of our domestic hen, the Hottentots commonly eat a whole one at a time.—(*Mr. Burcell's Travels in the Interior of Southern Africa.*

Musty Flour resotred.—Mr. E. Davy of the Cork Institution states, that a small quantity of the carbonate of magnesia will completely take away the unpleasant smell and taste from musty flour. He recommends it to be used in the proportion of thirty grains to one pound of flour. To make bread, it is to be leavened and baked in the usual way, and it will be found much lighter and whiter than when made without it: the bread is much more wholesome and agreeable than when alum is used.

Star Fith.—The most extraordinary of this tribe is the Medusa's Head Star Fish of Linnæus, called by some writers, Stella Arborescens. It grows to a great size, measuring full two feet in diameter when the limbs are extended. It is first divided into five equi-distant, jointed processes, each of which is soon subdivided into two other smaller ones; and each of these at a somewhat further distance, into two others, still smaller; this mode of regular subdivision, being continued to a vast extent, and in the most beautiful gradations of minuteness, till at length the number of extreme ramifications amounts to several thousands. By this most curious structure the animal becomes, as it were, a kind of living net; and is capable of catching such creatures as are destined for its prey, by the sudden contraction of all its innumerable ramifications, and thus the object is secured beyond all power of escape. Examples of this animal, well worthy of notice, may be seen in the British Museum.

Paper Nautilus.—" Among the principal miracles of nature," says Pliny, "is the animal called Nautilus, or Pompilos. It ascends to the surface of the sea in a supine posture, and gradually raising itself up, forces out, by means of its tube, all the water from the shell, in order that it may swim the more readily; then throwing back the two foremost arms, it displays between a membrane of wonderful tenacity, which acts as a sail, while with the remaining arms it rows itself along, the tail in the middle acting as a helm to direct its course, and thus it pursues its voyage; and if alarmed at any appearance of danger, takes in the water and descends."

The Lantern of Maracaybo.—This luminous phenomenon is seen every night on a mountainous and uninhabited spot on the borders of the river Catatumbo, near its junction with the Salia. Being nearly in the meridian of the opening of the lake of Maracaybo, navigators are guided by it as by a lighthouse. This light is distinguished at a greater distance than forty leagues! Some have ascribed it to the effects of a thunder storm, or of electrical explosions, which might take place daily in a pass in the mountains, while others pretend that it is an *air-volcano,* M. Palacios, observed it for two years at Merida. Hydrogen gas is disengaged from the ground in the same district; this gas is constantly accumulated in the upper part of the cavern *Del serrito de Monai,* where it is generally set on fire to surprise travellers.

Book of Eternity.—In Signior Castagnetta's account of the asbestos we find a scheme for the making of a book, which from its imperishable nature, he is for calling the Book of Eternity. The leaves of this book were to be the asbestos paper, the covers of a thicker sort of the same material, and the whole sewed together with thread spun from the same substance. The things to be commemorated in this book, were to be written in letters of gold, so that the whole matter of the book being incombustible, and everlastingly permanent against the force of all the elements, and subject to no changes from fire, water, or air, must remain for ever, and always preserve the writing committed to it.

Preservation of Cabbages.—In the Monthly Magazine for the present month we find the following excellent method adopted by the Portuguese on board their ships:—"The Cabbage is cut so as to leave about two inches or more of the stem attached to it; after which the pith is scooped out to about the depth of an inch, care being taken not to wound or bruise the rind by this operation. The Cabbages are then suspended by means of a cord, tied round that portion of the stem next the Cabbage, and fastened at regular intervals to a rope run across the deck. That portion of the stem from which the pith is taken, being uppermost, is regularly filled with water every morning. By this simple method the Cabbage is preserved fresh during pretty long voyages."

The same method might be advantageously adopted in private houses.

Emanation of Light from Various Solid and Fluid Substances, and Animal Matter.—The emission of light from the tail of the glow-worm is a fact with which every one is acquainted. A similar effect is known to be produced by several animal substances in a state of decomposition: and from decayed wood is experienced a like luminous appearance. Persons who have witnessed the beautiful phosphorescent effects of the sea, in a dark night, must likewise have been forcibly struck with the radiations of so singular a phenomenon. Such peculiarities in nature cannot be supposed to have escaped the notice of the prying philosopher. But it is only of late that a course of experiments has been made, which has produced inferences from these physical facts likely to affect the doctrines of solar light.

Newton, and other eminent philosophers, conceived the sun to be a vast body of fire: but the more improved instruments of Bode, Herschel, Schroeter, and other modern astronomers, have contributed to determine that the solar mass is opaque; and these opinions are strongly confirmed by the results of a long course of experiments made by Arago on the emission of light from bodies actually opaque, and which promise to solve many difficulties as to the physical constitution of the sun.

The Conductors to the Public.

☞ *Next Saturday, a Double Number of our Work will be published, which will contain the Title-page, Preface, Contents, &c. to the Fifth Volume. We will then explain more fully than our present opportunity admits of, what are our designs and prospects for the future.*

Meantime we may mention, however, that next Saturday's Number will complete the present series of the Glasgow Mechanics' Magazine, and very extensive preparations are now in a state of great forwardness for the commencement of a new, more important and highly improved Series.

We have never yet, since the commencement of our labours, expressed a single vaunting word of our exertions in aid of the cause of Science, or of what we have done to redeem our City from the disgrace which has ever hung upon it, of inability to support a Magazine of its own. We will then be compelled to state how little has been done by this City OF ITSELF, *to support this Work, and remove this disgrace.*

We maintain IT IS A DISGRACE TO THE CITY, *that a Periodical cannot be supported in itself and by its own resources. We have seen many laudable attempts made in the various departments of literature to establish a Magazine in town, and not a few of these since we ourselves commenced our labours, but all have sunk under that detestable spiritless indifference, or equally reprehensible lukewarmness, which has been the everlasting characteristic, we regret to say, of this City towards the prosperity of Periodical literature. We owe it not one iota of thanks for our stability. We are, and have been independent of its meagre support from the beginning. But more of this next week. Science, thanks to* ITS *supporters, will prosper without such aid.*

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THE GLASGOW MECHANICS' MAGAZINE,

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A Committee of Civil Engineers and Practical Mechanics.

> “*The people themselves* must be the agents in accomplishing the work of their own instruction. Unless they deeply feel the *usefulness* of knowledge, and resolve to make *some sacrifices* for the acquisition of it, there can never be any reasonable prospect of this grand object being attained.”—*Brougham.*

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ON THE LAWS OF THE EQUILIBRIUMS OF FLUIDS.

A BODY that is specifically heavier than a fluid, may be supported in it by the pressure upwards, if the pressure downwards is taken. Bodies specifically heavier sink, because the force wherewith they press downwards exceeds the pressure from beneath which opposes their descent, and the force wherewith they descend is equal to the difference of those pressures; if by any contrivance those two forces can be reduced to an equality, then the bodies will not descend but remain in the fluid. To shew this, here is a circular brass plate exactly fitted so as to cover the lower aperture of a cylindrical tube; I keep it close to the tube by this string, and now immerse the tube perpendicularly in water till the plate of brass is plunged therein somewhat more than eight times its own thickness; when at this depth, the piece of brass is supported by the pressure of the water, and does not sink though I let go the string.

The brass endeavours to descend by its own weight, it is pressed upwards by a weight equal to that of a cylindrical column of water having the same base with the brass plate, and being 8 times thicker; and because brass is eight times specifically heavier than water, the weight of a cylindrical column of water, which presses upwards, and the weight of the brass by which it endeavours to descend, will be equal, and consequently will be supported in equilibrio.

Again a body that is specifically lighter than the fluid in which it is immersed if the pressure upward is prevented. To prove this; here is a bit of cork so fitted to the bottom of this vessel, that the surfaces are every where in contact; now if you pour mercury into the vessel, you will find that the cork will not ascend till it be separated from the bottom of the vessel.

The effect of a fluid pressure in a direction contrary to that of gravity is here evinced by a very decisive experiment, as long as the fluid is prevented from communicating with the under surface, the cork continues attached to the bottom of the vessel partly by its own weight, and partly by the pressure of the mercury on its upper surface. From what has been already explained you must necessarily have discovered the rationale of sinking and swimming. When a body is bulk for bulk heavier than the fluid, by being immersed it loses only the weight of an equal bulk of the fluid, and consequently the residual or remaining gravity of the solid must carry it down to the bottom, or make it sink.

On the other hand, if the solid has less weight in the same bulk than the fluid, then it cannot by its weight displace or raise upwards its whole bulk of the fluid, but only so much of it as is equal to its own weight, and from the deficiency in weight, it will only be partly immersed, and will therefore swim upon the upper part of the fluid.

There are very few, if any animals, that are specifically heavier than common water. The substances indeed of both animals and vegetables are specifically heavier; the floating of either is therefore to be attributed to the cells or receptacles intersperced within them, which are filled with air, oil, &c. substances lighter than water; so that taken together, they form a mass specifically lighter than a comparative bulk of common water.

Further, the bulk of the body is increased by distending the chest in inspiration; this has been tried by an experiment on a fat man of an ordinary size by finding what weight he could support, so as to have the top of the head just above water. When his breast was full of air, he was found to rise with fourteen pounds of lead without striking out in the least, and two ounces more would have kept him under; but when his breast was not distended he could only bring up 11 pounds.

Of all the animals, however, thrown into the water man is the most helpless; the brute creation receive the art of swimming from nature, while man can only acquire it by practice, the one escapes without danger, the other sinks to the bottom. Some have asserted, that this arises from the different sensibilities each have of their danger; the brute unterrified at his situation, struggles, while his very fears sink the lord of the creation.

But much better reasons may be assigned for this impotence of man in water, when compared to other animals; and one is, that he has actually more specific gravity or contains more matter within the same surface than any other animal. The trunk of the body in other animals is large, and their extremities is proportionably small; in man it is the reverse, his extremities are very large in proportion to his trunk. The specific weight of the extremities is proportionably greater than that of the trunk in all animals, and therefore man must have the greater weight in water since his extremities are the largest.

Besides this, other animals to swim have only to walk (as it were) forwards upon the water; the motion they give their limbs in swimming is exactly what they use on land; but it is different with man, who makes use of those limbs to help him forward upon water, which he employs to a very different purpose upon land.

HEIGHT OF THE ATMOSPHERE.

VARIOUS attempts have been made to ascertain the height to which the atmosphere is extended all round the earth. These commenced soon after it was discovered, by means of the Torricellian tube, that air is a gravitating substance. Thus it also became known, that a column of air, whose base is a square inch, and the height that of the whole atmosphere, weighs 15 pounds; and that the weight of it is to that of mercury as 1 to 10,800: whence it follows, that if the weight of the atmosphere be sufficient to raise a column of mercury to the height of 30 inches, the height of the aerial column must be 10,800 times as much, and consequently a little more than five miles high.

It was not, however, at any time supposed, that this calculation could be just; for as the air is an elastic fluid, the upper parts must expand to an immense bulk, and thus render the calculation above related exceedingly erroneous. By experiments made in different countries, it has been found, that the spaces which any portion takes up, are reciprocally proportional to the weights with which it is compressed. Allowances were to be made in calculating the height of the atmosphere. If we suppose the height of the whole divided into innumerable equal parts, the density of each part of which is as its quantity; and the weight of the whole incumbent atmosphere being also its quantity; it is evident, that the weight of the incumbent air is every where as the quantity contained in the subjacent part; which makes a difference between the weights of each two contiguous parts of air. By a theorem in Geometry, where the differences of magnitudes are geometrically in proportion to the magnitudes, these magnitudes are in continual arithmetical progression; therefore, if, according to the supposition, the altitude of the air, by the addition of new parts into which it is divided, do continually increase in arithmetical proportion, its density will be diminished, or (which is the same thing, its gravity decreased) in continual geometrical proportion.

It is now easy, from such a series, by making two or three barometrical observations, and determining the density of the atmosphere at two or three different stations, to determine its absolute height, or its rarity at any assignable height. Calculations accordingly were made upon this plan; but it having been found that the barometrical observation by no means corresponded with the density which, by other experiments, the air ought to have had, it was suspected that the upper parts of the spherical regions were not subject to the same laws with the lower ones. Philosophers had recourse to another method for for determining the altitude of the atmosphere, viz. by a calculation of the height from which the light of the sun is refracted, so as to become visible to us before he himself is seen in the heavens. By this method it was determined, that at the height of 45 miles the atmosphere had no power of refraction; and consequently beyond that distance was either a mere vacuum, or the next thing to it, and not to be regarded. This theory soon became very generally received, and the height of the atmosphere was spoken of as familiarly as that of a mountain, and reckoned to be as well as certained, if not more so, than the heights of most mountains are. Very great objections, however, which have never yet been removed, arise from the appearance of some *meteors*, like large globes of fire, not unfrequently to be seen at vast heights above the earth. A very remarkable one of this kind was observed by Dr. Halley in the month of March 1719, the altitude of which he computed to have been between 69 and 73½ English miles; its diameter 2800 yards, or upwards of a mile and a half; and its velocity about 350 miles in a minute. Others, apparently of the same kind, but whose altitude and velocity were still greater have been observed; particularly that remarkable one, August 18th, 1783, whose distance from the earth could not be less than 90 miles, and its diameter not less than the former; at the same time that its velocity was certainly not less than a thousand miles in a minute. Fire-balls, in appearance similar to these, though vastly inferior in size, have been sometimes observed at the surface of the earth. Of this kind Dr. Priestly mentions one seen on board the Montague, 4th November, 1749, which appeared as large as a large millstone, and broke with a violent explosion.

From analogical reasoning, it seems very probable, that the meteors which appear at such great heights in the air are not essentially different from those which, like the fire-ball just mentioned, are met with on the surface of the earth. The perplexing circumstances with regard to the former are, that at the great heights above mentioned, the atmosphere ought not to have any density sufficient to support flame, or to propagate sound; yet these meteors are commonly succeeded by one or more explosions, nay are sometimes said to be accompanied with a hissing noise as they pass over our heads. The meteor of 1719 was not only very bright, insomuch, that for a short space it turned night into day, but was attended with an explosion heard over all the island of Britain, occasioning a violent concussion in the atmosphere, and seeming to shake the earth itself. That of 1783 also, though much higher than the former, was succeeded by explosions, and according to the testimony of several people, a hissing noise was heard as it passed. Dr. Halley acknowledged that he was unable to reconcile these circumstances with the received theory of the height of the atmosphere; as, in the regions in which this meteor moved, the air ought to have been 300,000 times more rare than what we breathe, and the next thing to a perfect vacuum.

In the meteor of 1783, the difficulty is still greater, as it appears to have been 20 miles farther up in the air. Dr. Halley offers a conjecture, indeed, that the vast magnitudes of such bodies might compensate for the thinness of the medium in which they moved. Whether or not this was the case, cannot indeed be ascertained, as we have so few data to go upon; but the greatest difficulty is to account for the brightness of the light. Appearances of this kind are indeed with great probability attributed to electricity, but the difficulty is not thus removed.

It appears, that the absolute height of the atmosphere is not yet determined. The beginning and ending of twilight indeed shew, that the height at which the atmosphere begins to refract the suns light is about 44 or 45 English miles. But this may not improbably be only the height to which the aqueous vapours are carried: for it cannot be thought any unreasonable supposition, that light is refracted only by means of the aqueous vapour contained in the atmosphere; and where this ceases, it is still capable of supporting the *electric* fire at least, as bright and strong as at the surface. That it does extend much higher, is evident from the meteors already mentioned: for all these are undoubtedly carried along with the atmosphere; otherwise that of 1783, which was seen for about a minute, must have been left 1000 miles to the westward, by the earth flying out below it in its annual course round the sun.

CARBONIC ACID.

This gas was formerly called aerial acid, fixed air, &c.

This air is found in three different states.

1. In the state of gas.—In this state, on account of the direful effects it produces, it has been called *cholk damp*. It is this gas which produces the strange effects in the grotto delcano so generally remarked by travellers.

2. Fixed air exists in a state of mixture, as in certain mineral waters, and may be obtained from them by agitating them in a bottle having a moistened bladder in its mouth; by distillation, or by precipitation of the fixed air by means of lime-water, and taking $\frac{13}{32}$ of the precipitate for the weight of the quantity of fixed air that occasioned the precipitation: for it has been found that 32 parts of chalk contain 17 of lime, 2 of water, and 13 of fixed air.

3. Fixed air is found in a state of combination. It forms about $\frac{1}{3}$ of the weight of lime-stone, marble, and some other calcaneous earths.

This gas may be obtained easily as follows:

Put some chalk or marble grossly powdered, into a bottle, and pour upon it some vitriolic acid, diluted with 4 times its bulk of water. The mixture will effervence, and heat will be produced, and fixed air will be copiously emitted.

Mr. Cavalls recommends the following method of obtaining fixed air in considerable quantities. Put equal parts of brown sugar and good yeast of beer into a bottle, to which add nearly twice the bulk of both, of water, then expose the bottle to a heat not exceeding 90°, it will yield fixed air plentifully.

The properties of fixed air are,

1. It is unfit for respiration. It produces many accidents at the opening of cellars, or places where wine, cyder, and beer are suffered to ferment. Birds exposed to this air immediately perish.

2. Fixed air is improper for vegetation. If the roots of plants that grow in common water are put in water impregnated with fixed air, they will all perish. Plants that can grow in water slightly acidulated with fixed air, emit a considerable quantity of vital air. In this case the acid is decomposed, and the carbonaceous principle mixing with the vegetable, allows the vital air to escape.

3. Fixed air is easily dissolvable in water. Water impregnated with this gas possesses very valuable medicinal qualities.

4. Fixed air is heavier than com-

mon atmospheric air in the proportion of about 68 to 45. On this account it may be poured from one vessel to another like other fluids. For the same reason, it always occupies the lowest part of the space in which it is contained.

5. It resists putrefaction. Hence it is, that substances in which this gas abounds, are very powerful remedies in all putrid diseases. It has been supposed that the frequent use of sugar, and fresh vegetables, which at this time make up a considerable part of the diet of the European nations, prevents those putrid diseases and plagues which were formerly frequent.

The atmosphere is a combination of two airs, viz. vital air, and azotic gas. We have already treated of the former, the distinguishing properties of the latter are, that it is destructive of animal life, but very favourable to that of vegetables. In a 100 parts of atmospheric air there are 28 of vital and 72 of azotic.

ON THE EXPANSION OF BODIES.

The expansion of bodies by heat is very various, and in solids does not seem to be guided by any certain rule. In the 48th volume of the Philosophical Transactions Mr. Smeaton has given a table of the expansions of many different substances. From these tables, it appears that no rule can be deduced concerning the degree of expansion to which bodies are subjected by the same degree of heat, either from their specific gravity or otherwise. Tin, which is much lighter than lead, expands more with heat; but glass, which is lighter than the other, expands much less; while copper, which is heavier than a mixture of brass and tin, expands less.

Of all known substances, those of the aerial kind expand most by an equal degree of heat; and in general the greater quantity of latent heat that any substance contains the more. Expansions in physology, the enlargement or increase of bulk in bodies, chiefly by means of heat. This is one of the most general effects of that subtile principle being common to all bodies whatever, whether solid or fluid. In some few cases, indeed, bodies seem to expand as they grow cold, as water in the act of freezing: but this is found to be owing to the extrication of an infinite number of air bubbles from the fluid at a certain time; and is not at all a regular and gradual expansion like that of metals or any other solid or fluid substance by means of heat. In certain metals also, an expansion takes place when they pass from a fluid to a solid state: but this too is not to be accounted any proper effect of cold but of the arrangement of the parts of the metals in a certain manner; and is therefore to be accounted a kind of crystallization rather than any thing else. The more easily is it expanded; though even here we cannot form any general rule. It is certain, however, that the most dense fluids such as mercury, oil of vitriol &c. are less expansible than water, spirit of wine, or ether. This last indeed is so easily expanded that were it not for the pressure of the atmosphere, it would be in a continual state of vapour. After bodies are reduced to a vaporous state, their expansion seems to go without any limitation, in proportion to the degree of heat applied; so that it is impossible to say what would be the ultimate effects of that principle upon them in this way. The force with which these vapours expand on the application of high degrees is very great; neither can we say, that any obstacle whatever is insuperable by them. On this principle, depend the steam engines so much used in various mechanical operations; likewise some hydraulic machines; and the instruments called *manometers*, which shew the vanation of gravity in the external atmosphere by the expansion or condensation of a small quantity of air confined in a proper vessel.

MISCELLANIES.

Red Snow.—Travellers who have visited the Arctic regions, mention various places where they have met with *red snow.* Captain Ross observed it on the coasts of Baffin's Bay; and in Spitzbergen it was, as we learn from Captain Franklin, very commonly seen. The tinge of red has, however, been found to have been received after the snow has fallen to the earth; and is communicated by an herb of the *Alga* species, which is common in Argyleshire, where the snow, after lying some time, receives the red hue, so much marvelled at by those who have navigated the high northern seas.

Unicorns.—A class of Indian peasants, who dwell in the districts of the Himalayah mountains, and deputations of whom visit Nepaul annually, for the purpose of trade or religion—one and all agree in asserting that a gregarious and graminivorous animal of the deer kind, out of the centre of whose forehead grows a spiral horn, inhabits the woody tracts beyond the Himalayah, named Chaugdung. They call this animal *Chiro*, the colour of which is bright bay, and its flesh is good to eat. Though tempted by the promise of reward, they uniformly refuse to procure a specimen of this animal, the existence of which has been so long disputed by naturalists. The *Chiro*, they say, is too fierce and powerful to be taken by their simple means; but horns, shed by the living, or remaining after they have died, are frequently found; which horns are dedicated to their divinities. And a specimen of one of which had been sent by Mr. Hodgson, assistant to the resident at Katmandoo, to the Asiatic Society of Calcutta, together with drawings of the animal, made by a Bhotea peasant.

The vital matter in animal bodies.—Sir Everard Home, in his Lectures on Comparative Anatomy, vol. iii. p. 42, speaking of the brains and nerves, says, that a "*transparent mucus* is not only one of the most abundant materials of which the brain itself is composed, but is the medium by which the globules of the retina are kept together, and that it serves the same purpose in the medulary texture of the nerves;" and hence, he infers "that the communication of sensation and violation, more or less, depends upon it." In confirmation of this doctrine, Sir E. H. quotes an opinion of Mr. Hunter, who said, "that so wonderful was the connexion between the brain of every structure of the body, that it was to be explained in no other way than by considering that the *meteria vitæ* was every where in one of two forms, collected into one mass in the brain, which he called *concervata*, and diffused throughout the body, which he called *diffusa*, and between which the nerves communicated.

By microscopic examinations of the brain, the globules vary in size, and the gelatineous medium, uniting different parts is not all of the same consistence; and hence it is assumed, that these various qualities are subservient to different functions of the mind.

Longevity of Toads.—Many instances are upon record of toads having been confined in cavities of rocks, and other close recesses, for a great length of time without any apparent means of obtaining food; but there are few cases which enable the naturalist to specify the definite periods which the animals may have lived in such a state of confinement. By a paper read by Major-General Hardwick in the Wernerian Natural History Society, on the 13th of November last, we are informed of the incarceration of a live toad in a well at Fort-William Barracks, Calcutta, for the long term of fifty-four years.

MATHEMATICS—*Principles of Notation in Mathematical Analysis.*—It is most desirable that the mathematicians of Europe should adopt a uniform system of symbolical language in all the investigations they make public; and, in order that this language may be uniform, it ought to be formed, on some fixed principles, calculated to insure precision and distinctness, and combining as much of symmetry and elegance as the nature of the subject will admit.

Dr. Young has attempted to introduce a regular system of this kind, with some most judicious improvements; indeed, we rather ought to say that he has given examples of the advantage of such a system in the valuable article *Fluents*, in Napier's Supplement to the Encyclopedia Britannica, and in his Illustrations of the Celestial Mechanics of Laplace. A condensed view of the nature of the principles and improvements he recommends in these works he has collected into one paper, with some additional remarks in the last number of the Journal of Science.

The advantage of uniformity is obvious; and if this be the case to those who endeavour to follow the improvements in Science, as they appear, it must be of inconceivably greater value to those who only occasionally consult scientific works. Dr. Young's improvements certainly contribute much to the neatness and distinctness of analytical expressions; they want, however, extending to the whole system of analysis. A little manual of analytic notation, from the hands of such an author, would be an important step towards the general adoption of a regular system, and if it were illustrated by notes, to shew the discordant forms at present adopted, in the works of eminent writers, it would much enhance its value: indeed, such a manual is much wanted.

We cannot, however, dismiss this subject without expressing our regret that Dr. Young should have abandoned the Newtonian system of notation with no better reasons for doing so than he has offered. In our opinion, it shews a decided want of respect to the memory of the first inventor of the method of Fluxions, to adopt the notation of the second inventor, if not the borrower of the first one's ideas, unless there was found a manifest advantage in the change. This WE contend, there is not.

The characteristic mark of Leibnitz has nothing to distinguish it from a common multiplier, and deprives us of the use of a letter; while it denotes, and was used to mark the quantity as, an infinitely small difference; and, therefore, ought to be used only by those who wish to perpetuate such an absurd view of the subject.

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